WILD HARVEST EXHIBIT

manufacturing methods of exhibit components

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"WILD HARVEST EXHIBIT"

Manufacturing Methods of Exhibit Components

Showcase Number & Title		Models
Showcase #1	Springtime Treats Thimbleberry (Rubus parviflorus)	Thimbleberry Bush Thimbleberry Shoot (growing)
Showcase #2	Springtime Treats Fireweed (Epilobium angustifolium)	Fireweed (mature) Fireweed Shoot (growing)
Showcase #3	Steaming Pit	Camas Bulbs (Camassia quamish) Steaming Pit and Installation of Plants
Showcase #4	Soapberry (Shepherdia canadensis)	Soapberry (fruiting) Soapberry Foam
Showcase #5	After the Meal	Bearberry (Arctostaphylos uva-ursi) and Habitat. Labrador Tea (Ledum groenlandicum) and Habitat Licorice Fern (Polypodium glycyrrhiza) and Habitat
Showcase #6	Drying Rack	Red Huckleberries (Vaccinium parvifolium) Huckleberry Mush Drying Rack and Habitat
Plant Model Making Techniques		"Leaf Impressions - 3 Methods" "Tapering Copper Wire"

THIMBLEBERRY BUSH (Rubus parviflorus)

Research:

Consultant:	Nancy Turner, Ethnobotanist
Photographs:	Donna Warren, Doug Sage, Laura Hargrave
Collecting Site:	Hydro line Right-of-way between Point No Point and Jordan River
Collecting Time:	June 15/82
Colour Sketches:	Debra Bates, Laura Hargrave
Preservation:	Donna Warren, Doug Sage
Model Maker:	Debra Bates
Techniques:	Donna Warren, Debra Bates
Additional Touch-ups:	Pat Scott

THIMBLEBERRY

Report on Construction of Thimbleberry Rubus parviflorus by Debra Bates.

Flowers - Petals

Equipment
- 6 mil polyethylene
- porcelain clay
- vacuum former
- scissors
- paint - white oil
- airbrush
- sharp metal tool for carving

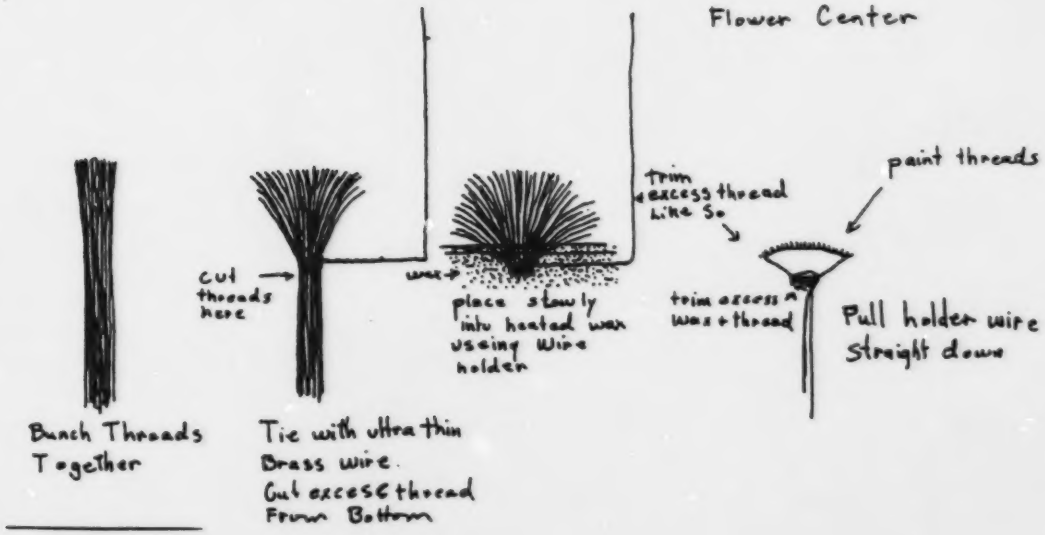
Using porcelain clay, I made a mold of 5 petals from a real flower. Once clay had dried, petals were removed and deeper relief was carved into the veins, and also crossing over the petal at right angles to the veins. This was done so that the detail of veins and the crinkle appearance of the flowers could be picked up by the vacuum former. *("Petals were then vacuum-formed from 6 mil polyethylene.") Once vacuum-formed, petals were cut out leaving a small tab of 1/4 - 1/2 inch at the base of each one for later assembly purposes.

Petals were airbrushed with 4 - 5 coats of white oil paint.

Calyx or Flower Centre — Thimbleberry

Equipment:
- thin brass wire
- scissors - manicure
- cheesecloth
- wax and waxing equipment
- paint (oil) - cadmium yellow, naples yellow, thimbleberry green

The centre of the flower is a small, round, slightly concave, light green object, with tiny yellow pistils or hair-like bits growing out of it. To achieve this structure I used cheesecloth threads tied in a bunch and wrapped with brass wire. The wire was then brought straight out from bundle for 1/2 inch and then bent upwards at a right angle. The wire was used as a handle as the threads could be dipped very carefully and slowly into green wax. Before dipping, the threads were splayed evenly to form a half sphere, so that the wax would fill in between the threads resulting in tiny individual threads on a round base. The threads were then trimmed and painted a soft bright yellow.

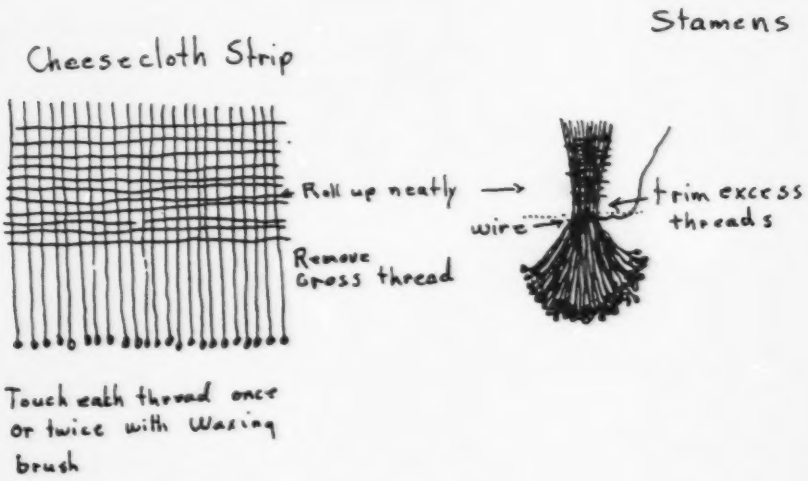

Flower Center
paint threads
Trim excess thread Like So
cut threads here
wax
place slowly into heated wax using Wire holder
trim excess wax + thread
Pull holder wire Straight down
Bunch Threads Together
Tie with ultra thin Brass wire. Cut excess thread From Bottom

Stamens - flower and berry Thimbleberry

Equipment:
- thin brass wire
- scissors - manicure
- cheesecloth
- wax and waxing equipment
- paint (oil) - yellow, raw sienna, raw umber
- comb or tool for separating threads

Cheesecloth was cut into strips about 2" wide and 4" long. Cross threads were removed for 1/2" on long side of cloth. This left a fringe of single threads which were combed into order. The tip of each thread was touched once or twice with the waxing brush. The wax was tinted light yellow, the colour of stamens on new flowers. Stamens for older flowers and berries were touched up with oil paint (a mixture of raw sienna and raw umber) after waxing.

Next step was to put stamens back into reasonable order, and carefully roll the cheesecloth strip into a tight bundle. Then wrap a brass wire about 1/2" up from stamen, to secure threads and cut excess thread off. About three strips were used for each flower or berry.



Berries and Buds — Thimbleberry

Equipment
- Silastic and thinner - catalyst
- small paper cups
- vacuum chamber
- scalpel for trimming excess epoxy
- wire
- airbrush
- paint - thimbleberry green, bloom rust

Ripe and unripe berries were carefully cut off at sepal with a scalpel and placed right side up on bottom of small cup. White glue was used to hold berry in place. Silastic* was used for the mold. Buds were molded in Silastic also, but were suspended slightly above bottom of cup from a wire which was pushed through stem and placed across cup which had been cut down to appropriate length. Epoxy was used for positive cast. How-ever, air bubbles were a problem, so epoxy was stirred very quickly until it turned white. For the stem, a piece of wire was bent over at the end and placed into the mold after epoxy was poured but before it hardened. For the buds, 5 thin wires were inserted in the end after casting to represent the ends of the sepals. This was done by creating a hole in the epoxy using a heated pointed metal tool and then gluing the wires in place with epoxy.

Finished berries were painted with several coats of a mixture of Rose Madder, Alizaron Crimson and Vermillion. However, this colour was not too close and another coat of Geranium Lake and Chinese Vermillion was added. Buds were painted thimbleberry green and oversprayed with the rusty bloom colour, which is Rose Madder and Raw Umber and a touch of Raw Sienna.

Some of the buds were real preserved buds taken from the preserved thimbleberry plant. A 1/4 inch of stem was left on these buds and a wire inserted into stem which was later glued with epoxy so that the epoxy formed the thickness of the stem and adhered to the preserved stem. These buds were airbrushed with thimbleberry green and then some thinned, white oil was hand-painted on parts where sepals had grown out and separated.

* Silastic is a room temperature vulcanizing silicone rubber made by Dow-Corning.

Flower and Berry Sepals Thimbleberry

Equipment:
- vinyl plastics - heavy (.015")
- piece of high-density blue Styrofoam
- metal tool with 1/4" - 1/2" curve
- alcohol lamp
- scissors
- airbrush

Patterns for sepals weren't, but should be, traced from real sepals. Sepals were cut from the heavier plastic. The indentations, of which there are two on each petal of each sepal, were formed by rubbing a slightly heated curved metal tool over the sepal which had been placed on the Styrofoam. They were painted thimbleberry green and given a dusting of the rusty bloom colour leaving some of them greener, etc. Also, a dusting of white was used intermittently. An alcohol lamp was used to give varying shapes prior to painting.

Leaf Stem Sepals

Equipment:
- 6 mil polyethylene
- porcelain clay
- vacuum former
- scissors
- paint (oil) - thimbleberry green
- scalpel

Sepals from a real plant were cut off with scalpel. They were mounted onto small bits of porcelain clay. They were vacuum-formed with 6 mil polyethylene and then cut out. To airbrush, sepals were pinned to styrofoam and two to three coats of thimbleberry green were applied on one side. Sepals are light in colour so painting needs to be light. The entire range of sepals was used, from the main stem where green branches join woody stock, to leaf stem sepals.

Leaves — Thimbleberry

Equipment
- 6 mil polyethylene sheet, size 24 x 16 inches
- vacuum former
- airbrush
- paint - (oil) varnish, thimbleberry green, lemon yellow
- wire - bendable (2 sizes) and brass wire
- scissors - manicure
- hot-glue gun
- heat-shrink tubing
- porcelain clay

For bulk of vacuum forming, flat leaves were used face down on felt platen. There are spots on vacuum former which are hot and others which are too cold. When plastic is overheated the detail may be excellent but plastic becomes weak and flimsy. Also, when plastic is too cool, detail is absent or faint. Therefore, much concern went into the placement of leaves onto the felt platen, so that the leaf would be adjacent to a medium spot on the heated plastic. The use of clean, unwrinkled 6 mil plastic helped. Plastic sheets for vacuuming were cut out with a couple of extra inches length and width to allow one to stretch plastic tightly over frame when heating process was going on.

Larger leaves had to be done one at a time to allow them enough medium heat area for a good take on all points. Many of the smaller leaves were fitted with a clay pedestal, so that the natural shape could be formed in one go.

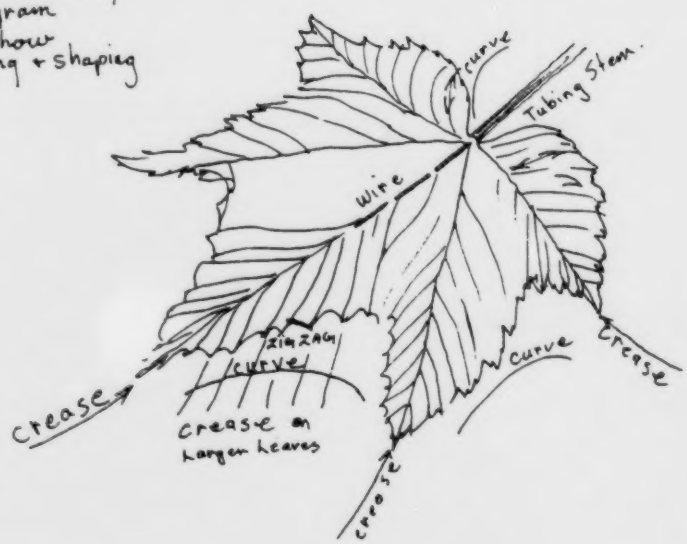
Making the clay pedestal is a fairly simple procedure, whereby a bit of clay is formed with fingers and/or tools into a 3D shape relative to the leaf. The leaf is then tamped face down onto clay. Clay may be manipulated and pushed up from underneath if required for fit.

After being wired, leaves were shaped with aid of an alcohol lamp. They were creased down length of main veins and heated carefully along length of leaf until plastic had softened, and then were held in a crease until cool, (a few seconds). Curves, etc., were pretty easy wherever needed. On larger leaves, veins other than main ones were also creased to give zigzag effect on outer edge of leaf. The only natural curves which were unattainable were where the leaf ends curve downwards along the main veins. The crease disallowed the plastic leaf to be curved. (Note: shaping of leaves is much more successful, i.e., no burn holes, if a heat-gun on a stand is used. See Thimbleberry Shoot report.)

Wiring

Most leaves were wired by weaving the appropriate size wire a little more than half-way down the centre vein of the leaf. Because of the vein indentation, a basting type weave was used with the larger spans of visible wire on top side. If basting was reversed, puckering ensued. Hot- glue was used at base of leaf to hold wire securely. Sometimes it was used to secure loose end of wire on underside of leaf. This is a good idea!

Thimbleberry
Diagram
to show
wiring + shaping



Stems — Thimbleberry

Equipment:
- heat-shrink tubing
- scissors

Heat-shrink tubing was employed as stem material for epoxy buds, berries, flowers and leaves. Tubing was hand-stretched to appropriate width for size of leaf or whatever. Hopefully, the stems tapered toward junction with leaf. Usually a portion of hot-glue ran down stem from base of leaf. This was trimmed up if needed and used as an anchor for stem, thereby forming a smooth looking joint. However, they should not be as dark as leaves. (Note: See Thimbleberry Shoot report for tapering leaf petioles.) (p. 15)

Painting Leaves

Leaves were airbrushed with 2 - 3 coats of lemon yellow and then 2 - 3 more coats of thimbleberry green to which 1/3 of varnish (Damar) was added. Underside was painted a mixture of thimbleberry green and white so that it was several tones lighter than surface of leaf.

Thimbleberry green:

Bellini Blue, Cadmium Yellow, touch of Rose Madder, touch of Prussian Blue, Lemon Yellow

Flocking — Thimbleberry

Equipment:
- spray adhesive
- air vent
- flocking

All stems were flocked prior to soldering. Work was done in front of an air vent to avoid breathing spray adhesive and flocking. Spray adhesive was applied to stem while watching for overflow on top sides of leaves. Glue can be removed with paint thinner and Q-Tips. Flocking was held in spoon and blown lightly across plant toward vent. After the waxing of branches, etc., was completed, flocking was applied in similar manner to branches and flowering tops except that a Q-Tip was used to apply adhesive to flowering ends.

Soldering

Equipment:
- solder gun, flux etc.
- heavy bendable wire
- wire cutters,
- brass wire
- sand paper
- small pair smooth, flat edge pliers

Main stem wire was sanded or else solder wouldn't take because of oil build-up. Leaf stem wires were clipped to approximate length of 1/2" - 1" depending on size, etc., and then bent downwards and straightened with pliers. Brass wire was wrapped around both main stem and leaf stem for strength and to hold leaf stem in place for soldering. Soldering was completed and flux washed off.

Waxing — Thimbleberry

Equipment
- scalpel
- pointed metal tool
- waxing brush
- wax mixture: Carnauba, Microsere, microcrystalline (yellow), beeswax, paraffin, touch of oil (melting point 120 degrees F)
- alcohol lamp for heating metal tools

Wax was tinted thimbleberry green. The first coat was brushed on heavily, excepting of course, on flower tops which were done very tediously. A scalpel worked well for trimming excess wax and shaping branches, to conform with squarish growth patterns. Waxing and trimming were continued until desired regularity and shape were attained. The heated metal tool and heated scalpel blade worked well for smoothing joins, etc. Stem sepals were waxed in place during latter stages of waxing. Sepals were adhered to stem by touching wax with hot metal and quickly setting sepal in position before wax hardened. A little more wax was applied to outside of sepal and hot tools were used to smooth out joins, etc. (Note: Sepals for fruiting tops were simply traced from real sepals cut out and shaped with aid of tweezers and alcohol lamp, so that they would curve around stem and curve outward away from stem slightly.)

Placement of branches in woody stem — Thimbleberry

Equipment
- Dremel drill
- 1/8 inch drill bit for holes
- white resin glue
- syringe
- epoxy glue

The woody stem from the original, preserved plant was used to mount branches. Sepals for connecting branches were left in place on woody stem. The drill bit was placed in centre of sepal where original branch had been removed. Woody stem was bent back slightly during this operation so that hole could be drilled as straight as possible downwards. Counting from top of plant, the first and third branches have weak spots where drill broke through to outside of stem. Therefore, all drilled holes were filled with white resin glue with hopes that it would soak into pith of stem and strengthen the areas. Glue was left over a weekend to dry and then holes were redrilled. A needleless syringe was employed to fill holes with epoxy glue, and then the wire ends of branches were inserted into holes. Flocking was left off of branch bases to allow room for handling during assembly. Spray adhesive was applied to these areas with a Q-tip and then flocked. Excess epoxy was cleaned off stem and extra sepals were applied where needed at joints of branches and woody stems.

Woody stem was then painted by brush with oil paint. Mixture - Burnt Umber, Raw Sienna, Rose Madder, white and black.

* Final Note. Plastic plant is a reconstruction of the original preserved plant specimen which was used as a blue print.

Thimbleberry bush - Additional touch-ups

The wire leaf stems were threaded through the leaf body as an initial fix. This bond was reinforced with glue applied to the top of the leaf. The glue used was made by dissolving 3" of hot-melt glue stick in 25 - 30 ml of turpentine for several days, then heating the mixture gently until smooth.

Over the original oil colour, a matching green oil colour was airbrushed to cover the glue and tone the entire body of the leaf. Then a yellow ochre colour was spattered on to break up the visual texture. The green colour was then airbrushed over the yellow ochre to disguise (obscure) any obvious spatter pattern.

Bug bites

Small areas of the leaf were rubbed vigorously with turpentine to remove patches of green paint, leaving a light yellow stained area. These areas could then be coloured with a brown ochre oil paint in turpentine and blotted dry to produce one type of bug bite.

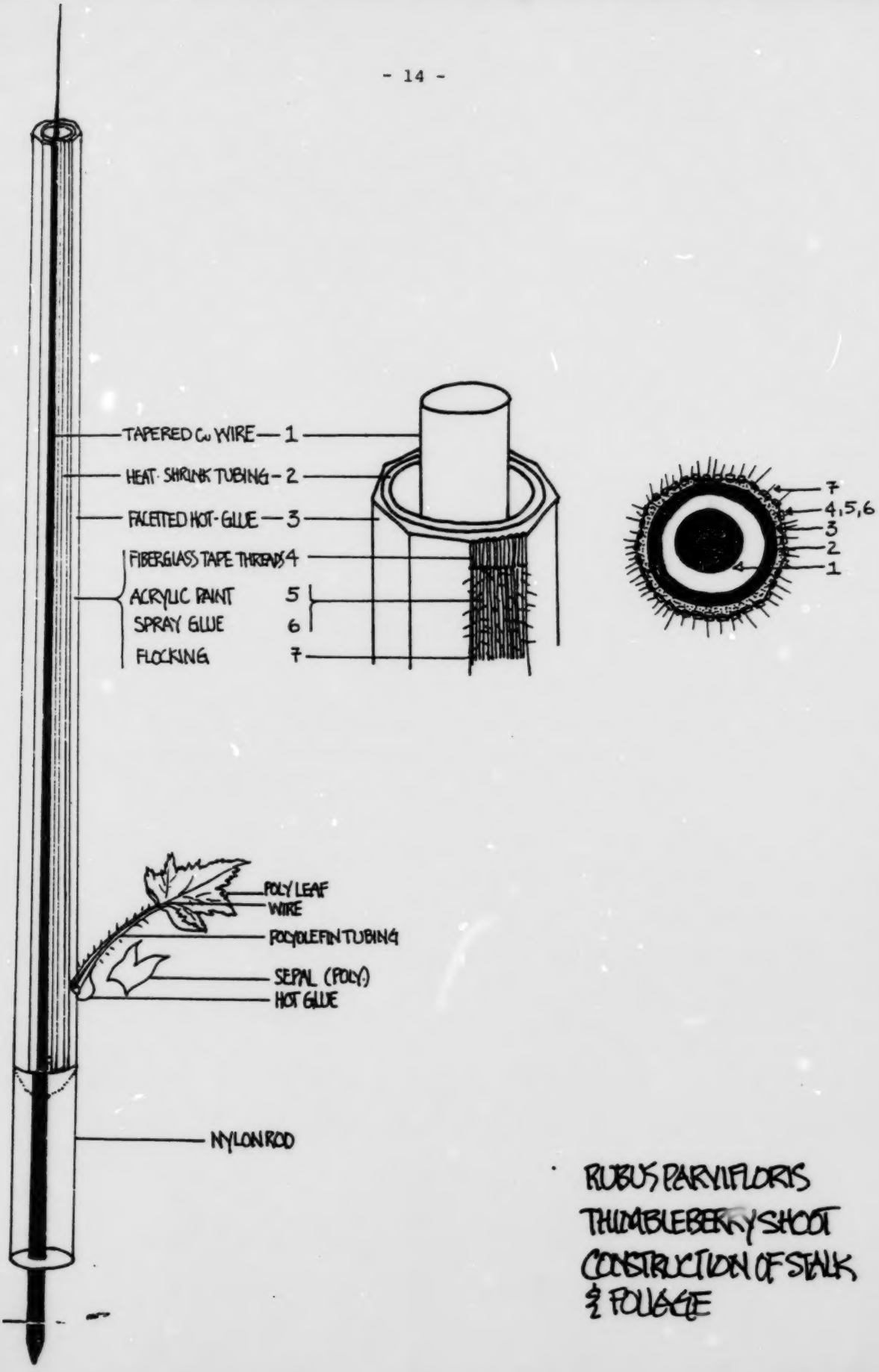
Using a hot wire, holes could be burned out, then surrounding edges coloured with a brown, or brown-green, or brown ochre oil colour.

Other areas were "laced" by pressing a hot, blunt tool repeatedly over a small area, leaving a filamentous section which could be coloured or burnt out with a hot wire.

THIMBLEBERRY SHOOT (Rubus parviflorus)

Research:

Consultant:	Nancy Turner, Ethnobotanist
Photographs:	Carol Christianson, Laura Hargrave Donna Warren
Collecting Site:	Jordan River/Point No Point area (Hydro Rights-of-way)
Collecting Time:	Late in April 1982 (was cold, though)
Colour Sketches:	Donna Warren, Carol Christianson
Pressed Plants:	Laura Hargrave, Used Botany Division's drier. Used for information on size, spacing
Model Maker:	Donna Warren
Techniques:	Donna Warren



RUBUS PARVIFLORUS
THIMBLEBERRY SHOOT
CONSTRUCTION OF STALK
& FOLIAGE

Leaves

Use #2 and #3 impression methods and vacuum-form from 6mil polyethylene sheet.

Cutting leaves

Since clear polyethylene is hard to read, it is much easier to cut the leaves from the poly if the real leaf is left on the poly when using impression method #3. If the leaf becomes detached from the poly, fasten it into place with masking tape. If #2 impression method is used, outline the edges of the leaves while the clay mold is still attached to the polyethylene, using a fine-tipped Staedtler Lumocolour 317 marking pen. Cut the poly leaves using manicure scissors.

Petioles

- Measure, from the dried plant, the length of petiole needed for each leaf.

- Decide how far the wires need to extend onto the blades in order to support the leaves (this is dependant upon the mass and weight of the individual poly leaves plus the strength of the tapered wire).

- Cut copper wires 3 times the length needed.

- Taper wires (see notes on wire-tapering) (p. 92).

- Cut 3/64" i.d. clear polyolefin heat shrinkable tubing to the lengths of each finished petiole. Angle both ends to enable a "natural", seamless join at the junctions of petiole/blade and the petiole/stem.

- Thread tubing onto appropriate tapered wires (leaving the appropriate wire extension at top end for blade adhesion).

- Heat-shrink to wire by running the tubing/wire over a heat-gun nozzle.

- Pull the tubing 1/2" down from its eventual position.

- Attach tapered wires to the blade of each poly leaf by running hot-glue into the convex blade (Bostik 1320 F. glue sticks fed through small hot-glue gun. Pre-modify the feed tip by hammering the opening almost shut, enabling a very thin stream of glue to escape). Unfortunately, the tip of this model is not removable, disallowing replacement with a custom-made tip. Very quickly heat the wire to be glued with an alcohol lamp or hot-air gun and melt it into the hot-glue (now well on its way to being cool) in the blade. Excess glue can be removed by using a hot metal tool with a curved tip and at the same time the wire can be pressed further into the glue, thus becoming encapsulated. Since the blades are concave on the front surface of the poly leaves, it is advisable to run the glue beyond the length of the wire (the wire rarely needs to extend the full length of the leaf).

- Attach tubing to the poly leaf by dropping a blob of hot-glue into the tubing and quickly forcing the tubing and glue up the wire to meet the poly leaf (thus forming the leaf/petiole junction). If there is an overspill of glue, carefully remove, and at the same time feather a tiny amount onto the tubing and poly to form an invisible joint.

Note: The terminal, inner apex leaf must have a very thin wire attached to it, with the tapered tubing made larger in order to slip the wire and tubing over the wire which extends from the top of the stalk. (See diagram).

Painting

- Apply all paint to front surface.

- Thin oil paints with mineral spirits only, not turpentine, which dissolves hot-glue.

- Hand-paint blade and veins a whitish/green/yellow (acrylic colours - Titanium white/Bellini Blue/ Hansa yellow med.). This gives the blade and veins the correct value.

  - Air-brush, oil paints and mineral spirits.
  - whitish/green/yellow (Lemon Yellow, Titanium White, Bellini Blue)
  - bright yellow (Cadmium Yellow med., Bellini Blue)
  - Bright green (Cadmium Yellow, Bellini Blue, Alizarin Crimson)
  - Darker green (Cadmium Yellow, Bellini Blue, Alizarin Crimson)

- Paint petioles a lighter colour.

- Shape each leaf (see notes on methods of leaf production #3).

- Flock only the front and backs of the leaves by lightly spraying the back surface with "Krylon" spray-glue. Taking some flocking in one's hand or on a spoon, gently blow the flocking over the surface. By blowing at right angles to the surface to be flocked, the flocking will settle "standing up" or at right angles to the surface, which gives the effect of real hairs instead of greeting card "velvet" - but it is fragile - so do not flock the petioles yet (since one still has to handle them).

Stem

Materials:

- PVC heat-shrink tubing
- 2 long narrow pans
- 2 hot plates
- 12 gauge copper wire
- hot-glue
- acrylic paints
- flocking
- alcohol burner and methyl hydrate
- metal sculpting tools, tweezers, scissors
- cooking oil
- 2 pair needlenose pliers
- copper sheet
- white/green oil paint
- fiberglass filament reinforced packing tape
- Krylon spray glue
- leather gloves

- Cut a piece of 12 gauge copper wire the length of the stalk plus 4". Make sure the wire is thinner than the tube - allowing space for wires of leaves to be inserted.

- Taper copper wire in Nitric acid.

- Stretch a piece of heat-shrink PVC tubing the length of the stalk to the appropriate taper and 3/4 the diameter desired (see notes on PVC tubing) (p. 41)

- Spray paint the interior of the tube and the copper wire a whitish/ green colour. This allows the wire to disappear in the tube while providing a translucency of the thickness of the walls of the tubing. When dry, slip the tubing over the wire leaving 4" of wire extending from the bottom and an inch extending from the top.

- a) Place two hot plates side by side. b) Place a copper sheet across the surface. c) Heat a long shallow pan (one that is 1 1/2 times the length of the tubing) of Bostik 1320F glue sticks. (These are less viscous than the pan-melt glue and harder to work with but give the required fleshy white colour that a real stalk has at its interior and adds more rigidity to the stalk and coats more thickly.) Slowly twirl the tubing portion of the tubing and wire in the glue, allowing the glue to extend into the holes in the tubing at either end, thus fixing the wire solidly in the tubing. This is a frustrating business. Oh yes, do this in a well ventilated area. When a somewhat even coating has been achieved, remove the pan from the copper sheet. Use the heated copper sheet to smooth the coating and then run one side of the coated tube evenly from one end to the other flatly over the edge of the sheet to form the facets for the stalk. Turn stalk and form the next facet, etc.

- Place a blob of hot-glue in the top and bottom cavities of the tubing. The stalk is now ready to have its threads applied. Oh La! Cut strips of fiberglass tape 1/4" wide and to the length of the tubular portion of the stalk. Adhere one strip to the glue surface. Burnish surface with a warm metal tool to start peeling away the backing of the tape by first of all heating the metal tool to the point where it will melt the adhesive and poly tape from the threads. Starting the peeling is crucial. As soon as you have a starter piece of the tape peeled away, without pulling away any of the fiberglass threads, using the hot tool, continue to pull the backing away to expose the next bit to be pulled. Continue down the stem, melting and pulling. Repeat with adjacent areas. Clean away any of the glue bits left behind from the tape on the stem by scraping with a hot tool, being careful not to melt the hot-glue coating nor to split the fiberglass threads.

Note: Pressure of the tool is quite light.

* Precurve any surfaces to be covered with tape. If one tries to bend after tape is applied, the tape will buckle.

- Paint stem with acrylics and a flat acrylic brush.

Sepals

Materials:

- 4mil polyethylene sheet
- high density styrofoam
- brushes
- oil paints and mineral spirits
- insect pin inserted into a piece of dowel (very handy tool)
- manicure scissors
- metal modelling tool
- vinyl sheet for masking

- Cut sepal shapes from the poly, using the pressed plant for sizes.

- Shape the sepal by pushing and pulling the polyethylene with the modelling tool into the surface of the high density styrofoam to form the concave and convex shapes desired. Pull tips for a really good point. Trim if too much stretching has occurred.

- Incise each sepal with tiny veins using the "insect pin pencil."

- Paint with acrylic paints

Assembly

Materials:

- hot-glue gun
- matches
- brush
- flocking
- tweezers
- alcohol lamp and methyl hydrate
- "Krylon" spray adhesive
- mineral spirits
- modelling tools (metal)
- small vice and/or styrofoam

- Use pressed plant as a blueprint for measuring spacing. Lay appropriate fake leaves and sepals onto the pressed plant.

- Place the stalk in a vice or a piece of styrofoam.

- Attach the first closed leaf to the wire that extends from the top end of the tubing/stalk (see leaf notes) by fitting the leaf tubing and wire over the stalk wire. Melt the leaf's tubing into the hot glue blob at the apex of the stalk.

- Place a small sphere of glue onto the base where the sepal belongs. Very quickly wrap the sepal around the hot-glue. Then work the edges of the sepal into the petiole and stem using a hot tool to form an invisible joint.

- Flock each leaf petiole and section of stalk as you proceed downwards.

- For the subsequent leaf attachments the only change in procedure is to bend the wire extending from the end of the petiole to about a 45 degree angle to the stalk surface; then heat the wire and force it through the stalk layers making sure the wire pierces the PVC tubing of the stalk.

- As you proceed, adjustments can be made to the curve of the petioles.

- At bottom end, attach a sound nylon rod, drilling out the diameter 7/8 the length of the wire to be inserted plus a bowl at the apex. (This was done for security purposes; tubing would crush and wiggle in the support.) Thread the nylon rod onto the wire. Before it joins the stalk, fill the bowl with hot-glue. Very quickly push the nylon rod to meet the stalk. Trim away excess hot glue.

- Flock (see notes in leaf and petiole section) the petioles and stalk one at a time as you work down the stalk. Instead of spraying the glue onto the surfaces, spray a small amount into a shallow bowl and mix with mineral spirits and brush onto surface to be flocked. Work quickly!! The blowing on of the flocking must be done with a light breath (experiment with it beforehand) also wait for one surface to dry before doing another, otherwise you will end up with double and triple the amount of flocking and have a very hairy plant (I am speaking from experience....sigh). Good idea to use a piece of vinyl to mask areas as one proceeds.

So, now it's done - install.

THIMBLEBERRY SHOOTS (Peeled)

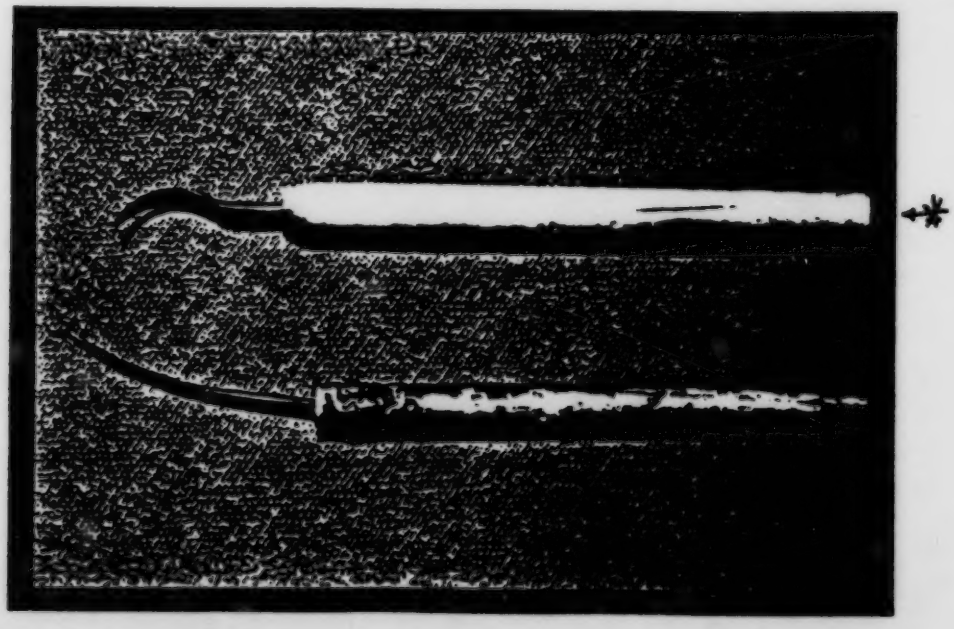
Research:

Consultant:	**Nancy Turner, Ethnobotanist**
Photographs:	**Robert Turner, Photograph from "Food Plants of British Columbia." Part 1/Coastal Peoples by Nancy Turner.**
Collecting Site:	**Sooke**
Collecting Time:	**May 1982**
Colour Sketch:	**Laura Hargrave**
Model Maker:	**Carol Christianson**

Thimbleberry Shoots (Peeled)

Cut 10 gauge copper wire to lengths greater than required for finished shoots, thus allowing handling without actually touching shoot. Taper wire in nitric acid (p. 93). Taper plastic tubing. Spray wire and inside of tubing with white enamel spray paint. Let paint dry and insert wire (wire should be flush with narrow end of shoot). Facet plastic tubing by holding against a belt sander (this method can also be used for tapering tubing). Apply fibreglass tape to outside of plastic tubing.

Cut tape into thin strips, long enough to cover length of tubing plus. Stick onto tubing one thin strip at a time, sticky side down. Using a hot tool (below) carefully remove the tape backing (it looks like polyethylene without its threads). With shoot held rigidly in place by a vice, scrape with right hand and gently peel the backing off with left (if you are right-handed). Keep cleaning the tool or it will leave burnt debris embedded into the tube. Try to keep fibres parallel. Press very gently against the tape or tool will melt through into the tubing. The result should be similar to celery strands. This technique will not work where finished shape of tubing is to be very curved (lengthwise), or if it is not held rigid after fibreglass is applied. This is another reason for having wire running through tubing.



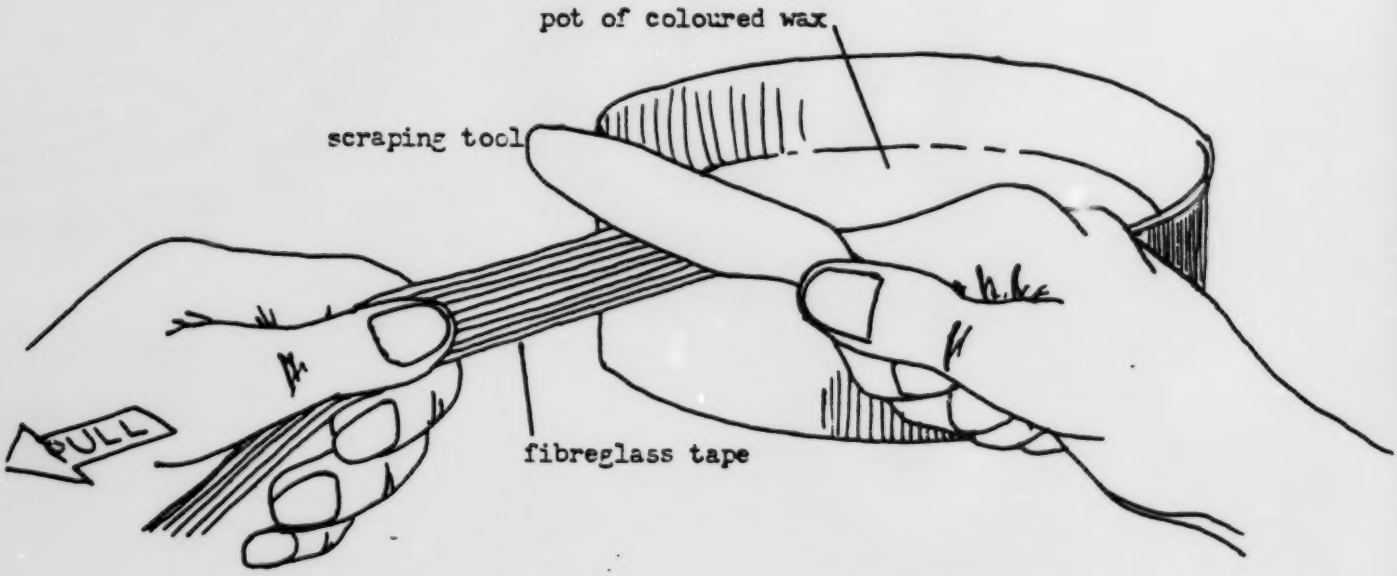
Mix oil paint (finished colour), mineral oil, and suitable waxes for outer coating of shoots. Apply wax quickly (long single brush strokes) to tubing. It will harden immediately. When completely covered with a thin coat of wax, scrape off excess or irregularities with a tool the same or similar to above. Using a bundle of thin guage wires held endwise to achieve a wire brush effect, gently scrape tiny grooves into surface of wax. This gives the wax surface that 'freshly peeled look'.

Cut excess wire from end of shoot. Fill ends with uncoloured paraffin/ microcrystalline wax mix. Shape and texture wax plugs with scraping tools and needles.

Partly peeled Thimbleberry Shoot

Procedure for making basic shoot same as above.

Peeling. Use fibreglass tape cut to desired shoot size. Run tape through a pot of coloured, melted wax (same as for outer coating of shoots). Use a scraping tool to scrape off excess wax and fibreglass threads by dragging tape over edge of wax pot as you pull it out of wax and gently pressing it down on the edge with scraping tool.



Flocking of partly-peeled shoot. Mask all of shoot except outer peeling with masking tape cut to shape and minimally adhered to shoot so as not to alter texture when removed. Apply spray glue to areas that are to be flocked. Blow flocking on until peeling resembles that of growing thimbleberry shoot. Allow to dry and blow off excess, unglued flocking. Remove masking tape. Use a small amount of paint thinner on a paintbrush to clean flocking off any areas where it does not belong.

See notes on Thimbleberry and Fireweed habitats for distressing of cedar bark mat and attaching of shoots to mats.

Fireweed and Thimbleberry Habitats

Research:

Consultant:	**Nancy Turner**
Photographs:	**Laura Hargrave, Donna Warren, Carol Christianson**
Collecting Site:	**Sooke**
Collecting Time:	**Early Spring, 1982**

Fireweed and Thimbleberry Habitats

Yew wood frames are built. These vary in size with the needs of the habitat to be exhibited but are the same size for fireweed and thimbleberry displays - 18" square and 4" deep. Basically they are 4-sided frames with a built-in wooden lip or shelf (dotted line in diagram) on which was placed the actual base of the habitat, also made of wood. On the larger habitats such as fireweed and thimbleberry, this lip was about 1/4" wide and 1/4" up from bottom of frame.

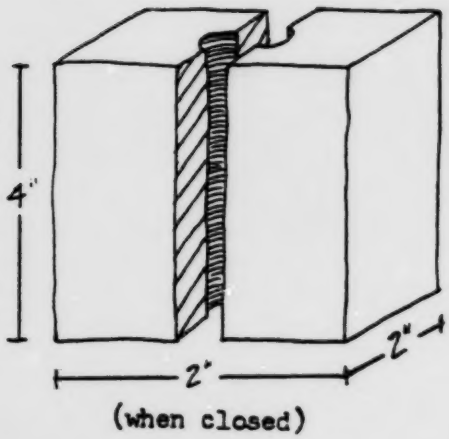
A 4" thick block of styrofoam was carved to form the basic habitat shape. Square holes (2" x 2" x 4") were cut out of the styrofoam where the plants would later be inserted. This was glued to the wooden base and covered with a rhoplex-saturated layer of soil. The habitat vegetation was then white-glued to the soil. This was done in a natural progression from basic materials like soil and moss to the loose-appearing top debris - leaves and twigs. Everything was sealed and made rigid by painting with vinyl sealer. Larger pieces of wood had been previously impregnated with vinyl sealer in a vacuum chamber.

Installation of Plants **Fireweed & Thimbleberry habitats**

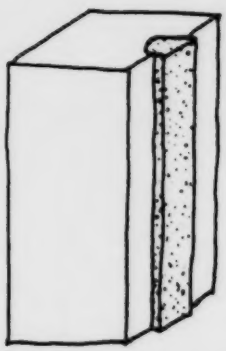
Cut wooden blocks the same size as the styrofoam holes. Drill a hole vertically into the centre of each, slightly larger in diameter than the stem of the plant to be installed. Then, cut each block in half through the middle of the drilled hole and separate the halves. Attach a cushioning material (sponge will do) to the inside surface of the holes to protect the stem from any possible damage due to contact with the wooden block.

- wooden block separated into 2 halves with hole drilled in middle

1/2 of wooden block with a piece of sponge pressed into the drilled hole

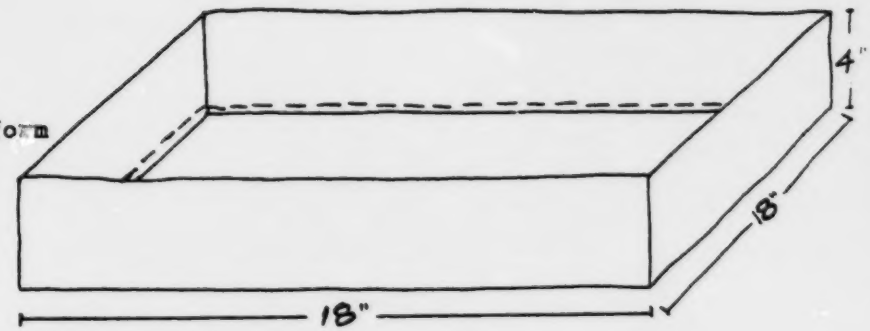


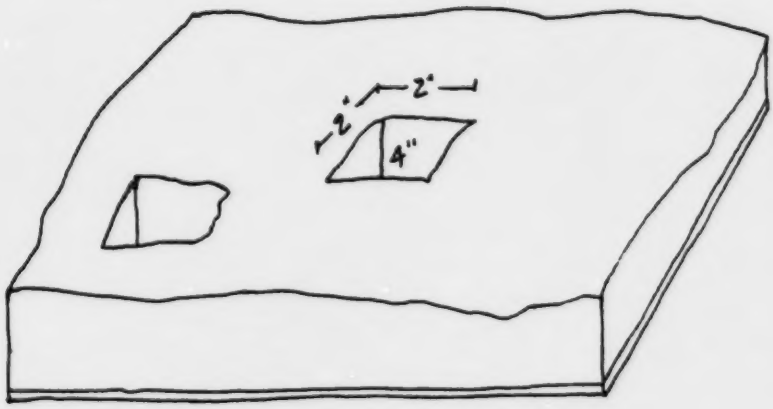
(when closed)



Loosely insert the two halves of the block into the hole in the habitat prepared for it and carefully fit the plant stem in place between them. Attach half of the block with screws to the base of the habitat. Tap a small wedge down the outside of the remaining loose half, thereby pressing it up against the secured half and tightly sandwiching the stem in place. When stem is held firmly enough, screw the second half to the base. This method allows for easy removal of the plants for repairs, etc.

styrofoam habitat form
on wooden base

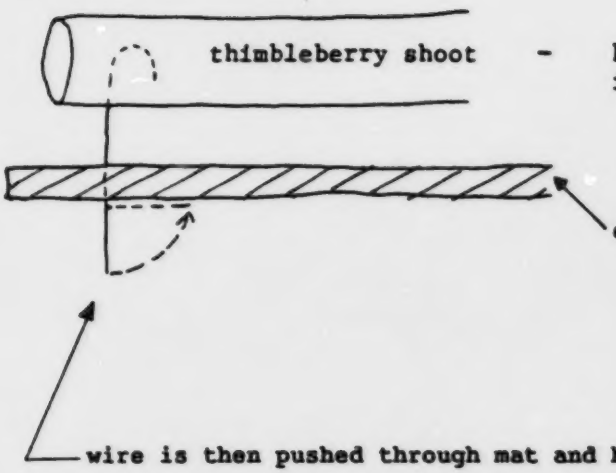




slightly smaller than 18" x 18" so that it fits easily into frame and rests on lip.

Once installed, the exposed bases of stems and blocks of wood are covered with bits of habitat which are held in place by strips of velcro (white-glued to moss and top of wooden block).

Habitat components are then painted by hand with acrylic paints, Seritint Liquid silk dyes, and Pelikan drawing inks. Fireweed and thimbleberry prepared shoots are displayed on woven cedar bark mats. Thimbleberry shoots are wired and hot-glued into place on the mat.



wire is then pushed through mat and bent at a 90 degree angle to hold it in place. Hot glue is applied to wire on bottom of mat.

Fireweed shoots are just hot-glued directly to the mat.

Two 3" pieces of wooden dowel are white-glued to the styrofoam base. Two pieces of naugahyde are correspondingly glued to the bottom of the mats. Glue is applied to the top of the dowels and the mats are pressed into place.

FIREWEED (*Epilobium angustifolium*)

Research:

Consultant:	**Nancy Turner, Ethnobotanist**
Photographs:	**Doug Sage**
Collecting Site:	**Ogden Point, Triangle Mountain**
Collecting Time:	**August 1982**
Colour Sketches:	**Laura Hargrave**
Model Maker:	**Debra Bates**
Techniques:	**Donna Warren**

FIREWEED REPORT

Construction of Plant Model
Epilobium angustifolium

1) Leaf Production process

2) Leaf Painting process

3) Flowers - Petals and Sepals

4) Flower Stems

5) Flower Stamens

6) Flower Pistils

7) Assembly of Calyx

8) Main Stem construction

9) Tip of Main Stem Construction

10) Wax Buds

Leaf Production Process - Epilobium angustifolium

Equipment used:

- scalpel
- live fireweed plants
- vacuum former - ADS 700 Series
- paper cutter
- modelling tools
- manicure scissors
- wire cutters
- Pyrex beaker
- alcohol lamp
- heat gun
- 4mil polyethylene
- 16" x 23" poly sheets
- porcelain clay
- 1/32" copper wire
- nitric acid
- hot-melt glue sticks
- methyl hydrate
- 1/8" white heat shrink tubing

About one-third of the freshly collected leaves were prepared (face down) on porcelain clay pedestals. This third ranged in size from 1 3/4" to 2 3/4" in length. For most of the smaller and larger sizes, flat leaves were placed face-down directly onto felt platen. Once formed and cut out, copper wires which had been tapered in nitric acid were glued at the base of the leaves in the indentation left by the main vein of the real leaf. To ensure a sound bond when using hot-glue and polyethylene it is helpful to raise the temperature as much as possible at point of glueing. I used an alcohol lamp for this and for pre-heating the copper wires before inserting them 1/4" to 1/2" into tip of glue-gun to obtain a thin, even and hot coat of glue. While protecting the rest of the leaf with fingers, base was heated quickly just before the heated and glue-coated wire (which was left in tip of glue-gun for 1 minute) was adhered. I also tried to seal the hot-glue by pressing the walls of the leaf vein together over the wire and glue. This will hopefully keep the oil paint from deteriorating the glue. (This also can be rectified by using mineral spirits instead of turps in the paint mixture.) Flat leaves were given shape using heat and holding leaf horizontally between fingers of both hands and then stretching the plastic at intervals at outer edge and down length of leaf.

Leaf Painting Process

To start with, both sides of the leaves were given two coats of Lemon Yellow followed by two coats, both sides, mixture of (Holbein Works):

- Sap Green
- Lemon Yellow
- Rose Madder with airbrush, of course.

The resulting colour being too bright, a darker mixture was used for the next three coats, both sides. During this stage of spraying, I tried to keep tips of leaves light in colour. This basic Fireweed Green was a mixture of:

- Sap Green - (Holbein)
- Lemon Yellow
- Hansa Yellow deep
- Bellini Blue
- Rose Madder

Next, the veins were hand-painted a light colour of:

- Titanium White
- touch Green
- touch Yellow
- some varnish

After veining had dried, one more coat of Fireweed Green (with some varnish added to it) was sprayed on top side of leaves. Veins which needed it were then cleaned with a thin paint brush.

The backs of the leaves were given two coats of a mixture of:

- Fireweed Green
- Varnish
- Green Earth
- Titanium White

The stripes on the back main veins were hand painted with a mixture of:

- Transparent Violet - (Holbein)
- Transparent Rose - (Holbein)
- Rose Madder
- Varnish

Flowers, Petals and Sepals

Live flowers and flower sepals were carefully dissected with scalpel blades and tweezers. They were then embedded onto small clay pedestals, face down, for vacuum forming in 4mil polyethylene. Once formed and cooled, pieces were cut out. Curved manicure scissors were needed for the inward curves of the petals. Petals and sepals were both painted with three to six coats, both sides, of a violet made from:

- Transparent Violet (Holbein Works)
- Transparent Rose (Holbein Works)
- Rose Madder

When the flower's petals reached an approximate depth of colour, tiny veins were hand painted onto fronts of petals. The colour was a purple made with:

- Fireweed Violet
- touch Bellini Blue
- thinned varnish - touch Alizarin Crimson

Once veining dried, one final coat was sprayed to give a light pink bloom. This colour was:

- Titanium White
- Rose Madder

The sepals were two additional coats, both sides, of a mixture of:

- Fireweed Violet
- Turquoise Blue (Holbein Works)
- touch of Alizarin Crimson

This gave them a darker, more burgundy hue, than the flower petals. Also, backs of the sepals were given one final light spray on the back, of a light mauve.

Flower Stems

The pod and stem which accompany each flower were made from 1/8" heat shrink tubing. The plastic was cut into 1 1/4" long pieces then threaded with wire of the same gauge as that used for calyx/flower stem.

About 1/2 to 3/4" of tubing was protected by fingers as the other end was heat shrunk down around wire. Pliers were used to pull the heated tubing and slowly stretch it to its thinnest width. Tubing was held until cool, then the thin end trimmed to 1/4 to 3/8". Large end was shrunk just slightly to finish. These stems were then airbrushed in two tones; top sides being a pastel purple mauve made from:

- Fireweed Violet
- Titanium White
- touch of Bellini Blue
- touch of Transparent Violet
- varnish

The underside light yellow-green - pastel:

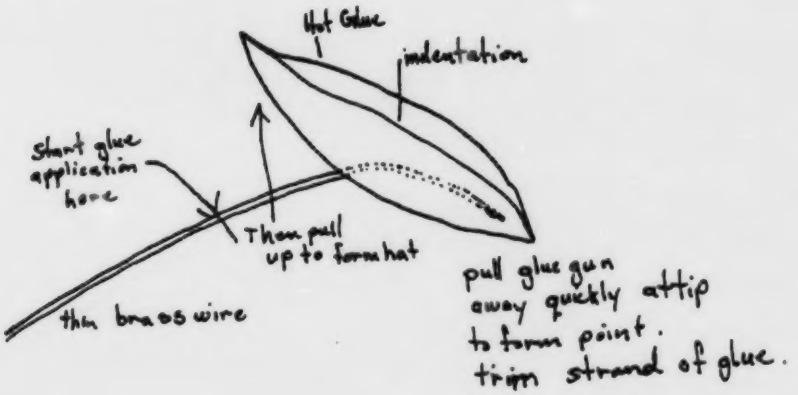
- Titanium White
- Fireweed Green
- Lemon Yellow
- Cadmium Yellow
- varnish

Once basic colour was established, but before final coat was sprayed, sides of pods were given hand-painted details of violet and purple stripes lightly along their lengths.

Wires used in processing were removed before final assembly. During final assembly of flowers, white glue was used to hold parts in place, such as between calyx and petals, petals and sepals, sepals and pod stem. Also, flowers and buds had tiny leaves attached by piercing base of leaf with a pin, then sliding it up the stem with a touch of glue added. Wires on flowers,
buds amd leaves were trimmed to 1/4" or so before assembly onto main stem.

Flower Stamens

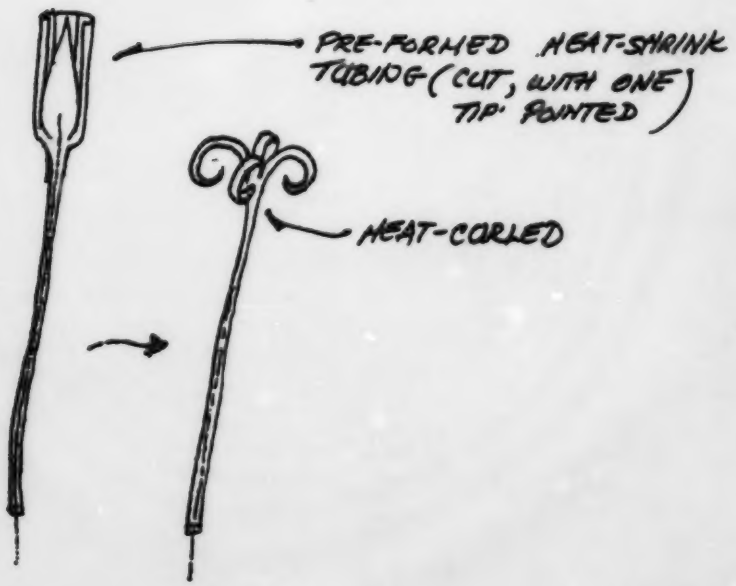
Stamens were made using thin brass wires cut into 2" lengths. Hot-glue was applied carefully up 1/4" from tip of wire, keeping glue to top half of wire for first 1/8" and then letting glue envelope wire totally at tip and then quickly pull glue gun away. A matte knife made the indentations. Stamens were painted white with acrylic. (Touch- up done later when plant was assembled. Colours used were Alizarin Crimson, Yellow and light green oil paints, very thin and brushed on.)


Hot Glue
indentation
Start glue application here
Then pull up to form hat
thin brass wire
pull glue gun away quickly at tip to form point. trim strand of glue.

Flower Pistils

The 1/8" heat-shrink tubing was cut into 1" lengths. A 3" length of brass wire was then threaded through the 1" tubes so that they were in middle of wire. While holding the tube in left hand, with fingertips protecting nearest half of tube, the end was heated until shrunk down over wire. Using needle-nose pliers in the right hand, the heated end was then pulled to stretch it still thinner. Tension was held until plastic cooled, then wire pulled up so that stem of pistil could be trimmed to about 3/4".

Next, the resultant large end of the tube was trimmed to 3/16" or less in length. Four equi-distant cuts were made about 1/8" or more down the length of tube. These formed the curled petals on pistil and had to be trimmed to form a pointed tip. Heated metal tools were used to form curls. A pair of tweezers heated on one half only were useful. Brass wires were trimmed and kept inside pistil for shaping.



Pollen: Done when plant was assembled, but should be done at time of construction of pistils.

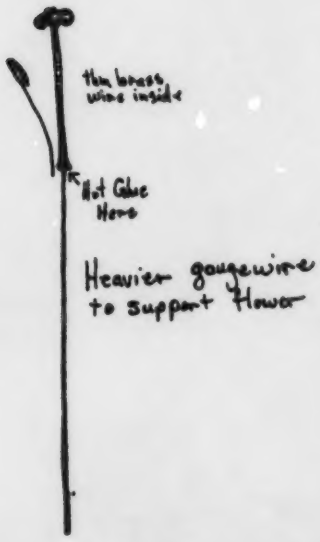
Method: A mixture of turps and spray glue (spray small amount into a saucer) was brushed onto one stamen. Then, very quickly, a brushing of Aerosil was brushed over the glue. When dry and stable, a very light yellow thinned oil-and-turps colour was put on - don't get the stamen too wet with paint - it will dissolve the glue and Aerosil.

Pollen: Method done at time of construction.

Method: Apply spray glue. Dip ends of pistils into Aerosil. When dry, airbrush with light yellow oil paint.

Assembly of Calyx

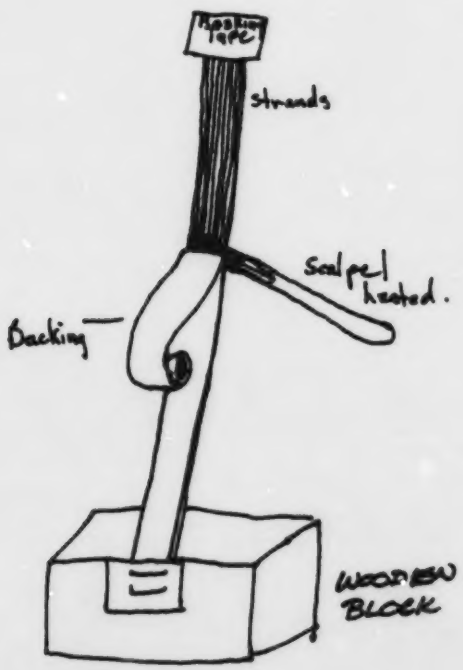
Quickly dip end of pistil into a drop of hot glue. This will expand the end of tube slightly to allow a heavier gauge wire to be inserted into it. Once wire in place, then a bead of hot glue was run around joint. If too bulky, this glue was trimmed once it had cooled. The stamens were arranged around this glued end with the tops of all stamens facing the pistil. To tack each stamen in place, each one had to be positioned and held in place, while a hot pin melted the glue under end of stamen. A very thin coat of 5 min. epoxy was applied over this end for strength and appearance. Painted acrylic Titanium White.



Main Stem Construction

PVC tubing was stretched as thin as possible by immersing in hot oil, then placing one end in vise and pulling, using pliers to grip oily tube. Strands which had been separated off fibreglass tape were used to give detail to bottom third of the stem. I found that heating the backing of the fibreglass tape with a hot iron and then cooling it caused a shrinkage in the tape backing. This shrinkage made it easy to separate the glued strands from the backing, by running a heated scalpel blade between the two.

The tape had small squares of masking tape at either end before process was begun. One end was stapled through masking tape to wooden blocks. The other end was hand-held. It was very easy to get strands sticking to each other once backing had been removed and masking tape at ends helped keep strands in line.



Tip of Main Stem Construction

A tiny bead of light green wax was used to finish the end of the main supportive wire, which protrudes past the end of the PVC tubing by 1 1/2". The wax was pin-pricked, (see colour sketch notes) then 5 min. epoxy glue was used to taper from end of PVC to tip. The first ring of the smallest buds was applied using tweezers to hold bud, dipping wire tip in epoxy glue and anchoring wire into wax tip of main stem. The next few sizes of buds had to be held in position while glue set. The next size of bud (which could be held by hand) had a tiny bead of hot-glue put on end to tack in onto main stem. An overcoat of epoxy was applied once several buds were in place and used for strength and to smooth joins. The tiny under-leaves were made for these buds by heating a pin, then obtaining a tiny drop of hot-glue on the end of a pin which was quickly stuck as directly under the bud as possible. Pin was then pulled downwards. The glue strand, once cooled, was slightly trimmed to the appropriate length for each bud.

The very tip of the stem was hand painted a light Yellow Green/oil and varnish. The rest of the stem was airbrushed in two tones. The green half being a light Fireweed Green, the red half was Fireweed Violet with a touch Alizarin Crimson and varnish.

Wax Buds

Equipment used:

- wax heating element
- wire cutters
- scalpel
- waxing brushes
- oil paint
- Wax:
  - 1/2 caurnauba
  - 1/4 paraffin
  - 1/4 beeswax
- brass wire
- thin bendable wire

Coloured wax dips were prepared. Three colours were used, the darkest was made from Fireweed Violet. The next shade was half a tone lighter, less oil paint being used gave it a more pastel colour. The light green was the third colour made with the addition of a bit of green and yellow to wax. Buds were dipped in colour according to size, the smaller buds having greenest stems and more of the pastel Violet on bud. Three quick dips of the green were sufficient for stem width, then two more dips of pastel Violet for pods. Main bodies of bud were done in three to five coats of green with one to two overcoats of pastel or Dark Violet. Sometimes a final or pre-final dip in boiling water was beneficial to blending, etc. Violet colour could be brushed on top half of bud also. The only hand-forming done was to pinch ends of larger ones, as forming was done, to get tips of buds. A heated scalpel added detail of four separate sepals on larger buds.

Buds were tested at 110 - 120° F for three hours; average temperature being 115° F. Buds showed no sign of melting. Wax was not soft and form was stable, the only difference being a glistening look.

It was found that these buds looked too waxy, therefore, the buds were brushed, after assembly, with striations of whitish green, rosy pink and clear purple oil paints. Before the paint was dry, Aerosil was dusted only the surface to give a dusty bloom.

FIREWEED SPLIT SHOOTS

Research:

Consultant:	Nancy Turner, Ethnobotanist
Photographs:	None
Collecting Site:	Sooke
Collecting Time:	End of April, 1982
Colour Sketches:	Laura Hargrave
Model Maker:	Carol Christianson
Techniques:	Buddy Williams Carol Christianson

Fireweed Split Shoots

Make Silastic molds from real split shoots. When hardened, reheat molds in oven. Cast in hot-melt glue. Using small-tipped hot-glue gun, force glue into heated molds. As hot-melt glue tends not to run, be very careful not to get bubbles in glue or miss any parts within mold - easiest if one person spreads mold while another injects glue.

Remove cast shoots from molds when cooled. Do not stretch shoots - hot-melt glue has little memory. Sand off irregular backs of shoots on belt sander until fairly smooth. Mask inside of shoot by hand painting latex rubber into them, 2 - 3 coats, being very careful to have clean lines along outside edges.

Painting - mix oil colours and turpentine for air brushing:

- 2 coats white
- light green
- finish with green and, if desired, pink
- final coat of damar varnish

Refer to photos and colour sketches. Alternate paint with light sprayed coats of damar varnish. Allow paint and varnish to dry between coats.

Remove latex rubber masking. Inside flesh will be correct colour without painting.

Melt a small amount of light green wax; if pink was used, melt some pink wax as well. Apply a bead of wax with a small brush just along edge of stem where skin meets inside flesh. When hardened, very carefully shape by scraping with sharp tool. Blend wax into rest of painted stem.
Note: If shoots bend, wax will crack, so avoid all handling once wax has been applied.

Lightly spray inside flesh of shoots with Blair spray varnish (100% pure gloss damar varnish) so that tiny separate drops land on flesh to resemble moisture. With fingertips, gently wipe edges of skin to re-dull. Only the flesh should appear moist.

Fireweed Shoot (growing)

Stem - 10 gauge copper wire cut overlength to allow for handling, and tapered in nitric acid. Cut a piece of plastic tubing overlength but not as long as the wire. Taper slightly by dipping in a pan of hot oil and stretching. Spray white enamel onto wire and inside tubing. Allow to dry before inserting wire into tubing. Bend to desired finished shape (wire will hold plastic in this shape). Apply fibreglass tape using same method as with Thimbleberry shoots. Cut tape into very thin strips when they will be on a curved surface. Wider strips will buckle along edges. Paint appropriate colour, alternating between coats of paint with Blair spray varnish (100% pure matte damar varnish). Finish by hand-painting on a light coat of coloured, melted wax. (See Thimbleberry shoots, peeled for waxing procedure.)

Leaves - 6mil polyethylene vacuum-formed over real leaves (underside face-up, or face-down). Shape leaves by holding over alcohol lamp or heat gun (preferable to alcohol lamp) and curling with fingers.

Painting - (oil paints and turpentine):

- Airbrush, starting with white (front and back)
- Light green - front and back
- Hand-paint back vein (light flesh-coloured acrylic paint)
- Medium green (front and back)
- Hand-paint front veins same as back.
- Medium green on front again.
- Pink on front and back (optional).
- Finish with matte damar varnish spray.

Refer to photos and colour sketches for painting. Allow to dry between coats. (Alternate between coats with light sprays of damar varnish. Aids in drying and fixing paint.)

Attaching leaves to stem - Using a real plant (can be dried) mark out on a 1:1 size piece of paper, where leaves are on stem. Do front of stem, then back. When attaching leaves to stem, lay fake stem alongside this rough drawing. Spray some 3M 90 spray adhesive into a small container. Apply a drop of glue to end of leaf to be glued. Press gently into place on stem with fingers. Allow glue to dry. Using a hot tool, remove excess glue or parts of leaves that don't adhere flatly to stem. Be careful not to ruin paint job on stem. Melt some wax, same as was used for stem. Using a brush, apply a small amount to bases of glued leaves to smooth join to stem. Shape wax with a scraping tool. Remove any excess wax. Follow paper pattern until appropriate sized leaves are attached at appropriate places along the stem.

Steaming Pit

Research:

Consultant:	**Nancy Turner, Ethnobotanist, C. Cox, Botanist**
Photographs:	**Buddy Williams, Pat Scott, Grant Hollands, Doug Sage**
Collecting Sites/Times:	
Cedar Bark Mat:	**Education/Extension Division**
Cinquefoil:	**San Juan River Mouth, March - April, 1982**
Camas bulbs:	**Hydro Right-of-way/Prospect Lake Road, mid-May, 1982**
Bracken/Salal:	**Wishart Road, July, 1982**
Alder/Swordfern:	**Wishart Road, July, 1982**
Grass Sod/Sand:	**Island View Beach**
Rocks:	**Clover Point**
Contractor: Mold	**F.R.P. Layup - C.I.F.**
Personnel:	**B. Williams, D. Sage, G. Harper, N. Turner, D. Bates, P. Scott, C. Christianson, D. Warren, L. Hargrave, A. Aikins**

Cross Section of a Steaming Pit

Pit Model

The 'cutaway' form was built up of a wooden form with cut pieces of roughly-contoured sheet FRP applied over it. A 4" recess was left for the vegetation. Edges and corners were puttied with aerosil-filled polyester resin paste. Small rocks were split and glued onto the surface with polyester resin. FRP rocks were made in the usual fashion from rock molds for the 'fire rocks,' used for lining the bottom of the 'fire pit'.

This finished form was then used to make a latex mold, and a lightweight FRP final piece was cast from this. The final cast was then resurfaced with sand by sprinkling sand from the various strata onto a brushed-on coat of catalyzed liquid polyester resin, and brushing off the excess sand when dry. The rocks were then hand-painted with acrylic paints.

Top

The form was sawn through along the intended line of the cedar bark mat, (except at the top of the recess) and wedged open. The cedar bark mat was cut into strips approximately 4" wide, and one edge was bound with cloth strips and acrylic resin. The strips were inserted into the gap (bound edge in) and glued in place with hot-melt glue. The wedges were removed, and the edges filled in with a mixture of sand and vinyl sealer.

Fumigated, dried-grass sods were consolidated and glued onto top edges with vinyl sealer, and the edges were jointed-in with a dirt/vinyl sealer mix. Grass root hairs were glued in below surface level with vinyl sealer. FRP rocks (used to hold down the cedar bark mat) were glued down with polyester resin. Final layers of sand on top of mat and around the rocks were fixed with vinyl sealer.

Recess

At the bottom of the side recesses, the 'hot' rocks (molded in) were painted with acrylic paints. Charcoal was obtained from a wood fire, and the individual pieces were consolidated by submerging in a 60/40 mixture of vinyl sealer/methyl hydrate and subjecting it to a vacuum of -1 ATM. When the vacuum was let off, the charcoal pieces were allowed to dry, then were glued into position around the 'hot' rocks with hot melt glue. The gaps around the charcoal were then filled with sand, with vinyl sealer being used to cement the sand.

A hardboard panel was prepared to fit into the recess between the 'hot' rocks and the cedar bark mat (one for each side). The panel was fitted with threaded studs so that it could be bolted to the recessed panel with nuts from inside the model. Vegetation layers were sketched in, and cardboard templates made up for each layer.

Vegetation

Clover rhizomes.
Fresh clover was harvested from the San Juan River mouth area. The roots were washed, separated, washed again, then tied into bundles and preserved in an alcohol/glycerine preservative for 9 - 12 weeks. Bundles were removed from the preservative solution and allowed to dry (6 - 8 weeks). The bundles were dipped in, and sprayed with, a 60/40 vinyl sealer/methyl hydrate solution and allowed to dry. They were then cut (where necessary) and arranged as a cross-sectional layer on the hardboard panel and adhered with polyester resin (injected at the base) and/or hot-melt glue.

Camas bulbs.
Fresh camas bulbs were harvested from the Hydro Right-of-way off Prospect Lake Road. The bulbs were cleaned up by washing and/or peeling, and rubber molds were made up of individual bulbs. At the same time, a base plate was made by glueing cut half-bulbs to a plate cut to the shape of the bulb layer template. A rubber mold was made from this, and the final baseplate was cast in polyester resin.

The individual bulbs were cast in wax (60% parowax, 40% microsere #5906, with 1/4 teaspoon pearlescent powder per cup of wax).

The cast bulbs were cleaned up with tools to remove flash lines and to add details where necessary. They were then painted with oil paints mixed with japan dryer. The base coat was a thin wash of naples yellow with silk white pearlescent powder dry-blended in for the peeled bulb colour. The skin areas were done with ochres, umbers, unbleached titanium and white, again with the silk white pearlescent powder dabbed on and blended in. For areas with encrusted dirt, burnt umber was rolled or dabbed on, and dirt was sprinkled into the wet colours.

The finished bulbs were hot-melt glued to the baseplate, and some pieces of skin were glued on with vinyl sealer.

Cinquefoil roots.

Fresh cinquefoil was harvested from the San Juan River mouth area. The roots were separated, washed, and preserved in a glycerine/alcohol solution for 9 - 12 weeks. The roots were bundled and tied prior to preserving. The bundles were allowed to dry (6 - 8 weeks) and were then dipped in and sprayed with, a 60/40 solution of vinyl sealer/methyl hydrate. After drying, the bundles were mounted in place on the hardboard panel with polyester resin injected at the base.

Leaf layers.

Appropriate vegetation (sword fern, bracken, salal, alder) was collected, preserved, allowed to dry, and colour was touched up with acrylic paints. Compressed leaf layers (approximately 4" x 24") were made up as follows:

Two pieces of light material (mahogany plywood approx. 8" x 28") were drilled with holes to easily pass a piece of soft wire through (refer to Fig. E. for accompanying diagram). Wires were cut to a length of approximately 10", and one end of each wire was knotted. One piece of ply was laid on a surface with the wires sticking up from below.

The leaf material was then loosely piled up on top of the plywood, around the wires, to a height of 6" - 8" (Fig. A & B). The other plywood plate was fitted down over the tops of the wires and the entire stack of material was compressed to the desired thickness (3" - 4"). The wires extending above the top plate were then knotted (rolled or crimped) to hold the 'sandwich' tight (Fig. C). This 'sandwich' was then bandsawn lengthwise through the middle. The sawn edge was made to stand up in a pool of liquid latex rubber, and left to dry (Fig. D). The plywood and wires were removed and a burlap backing piece was added to the latex with more liquid latex to add strength to the piece, and when dry was cut to final size and shape with scissors and scalpels. These layers were then air-brushed with acrylic colours/acrylic medium. The prepared leaf layers were then screwed or glued into place, and could be cropped or trimmed to the desired depth.

Additional material needed at edges and corners was fixed in place with hot-melt glue. Final colour touch-ups were done after assembly with acrylic.

STEAMING PIT LEAF LAYER FABRICATTION

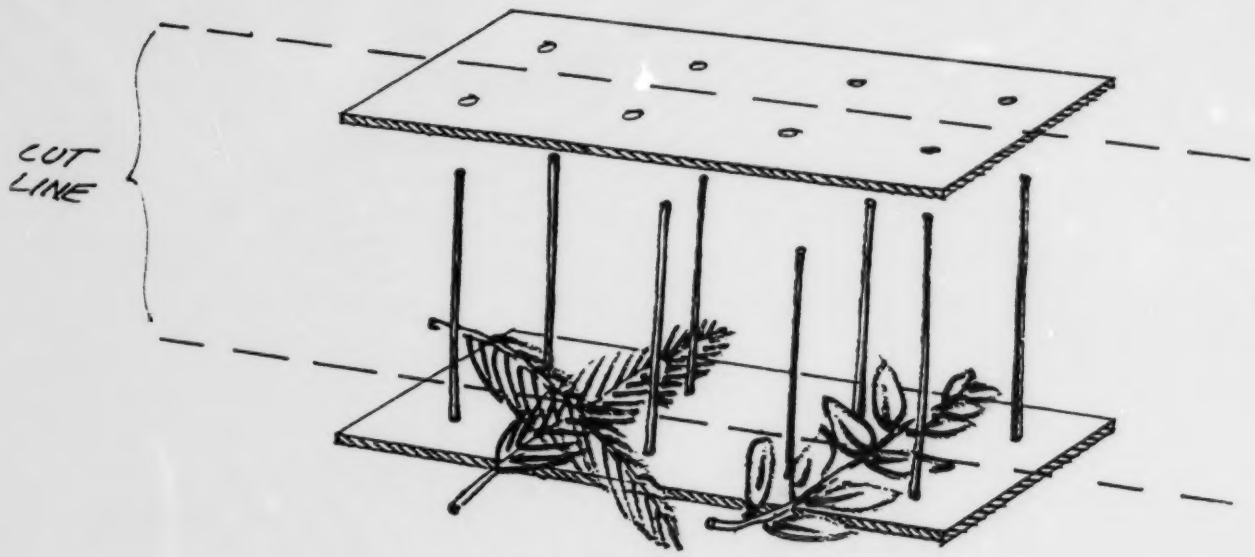


FIG A · STACKING THE LEAF LAYERS

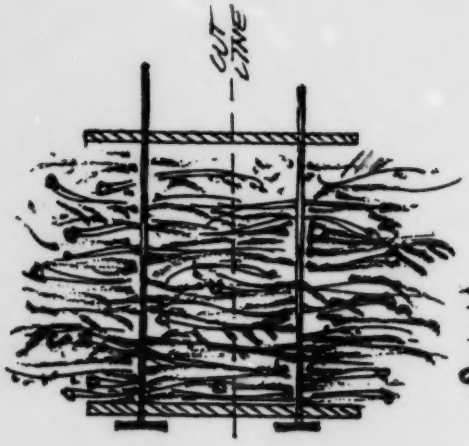


FIG. B · STACKED
· END VIEW

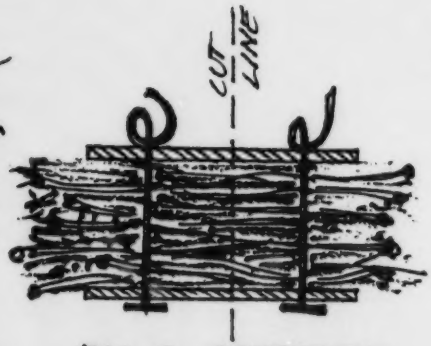


FIG. C · COMPRESSED
· END VIEW

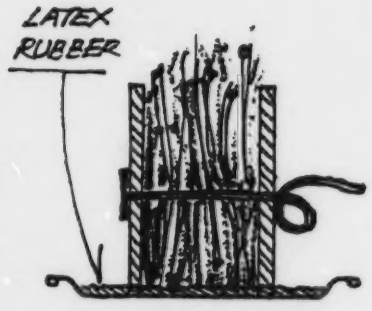


FIG. D · LATEXING
· END VIEW

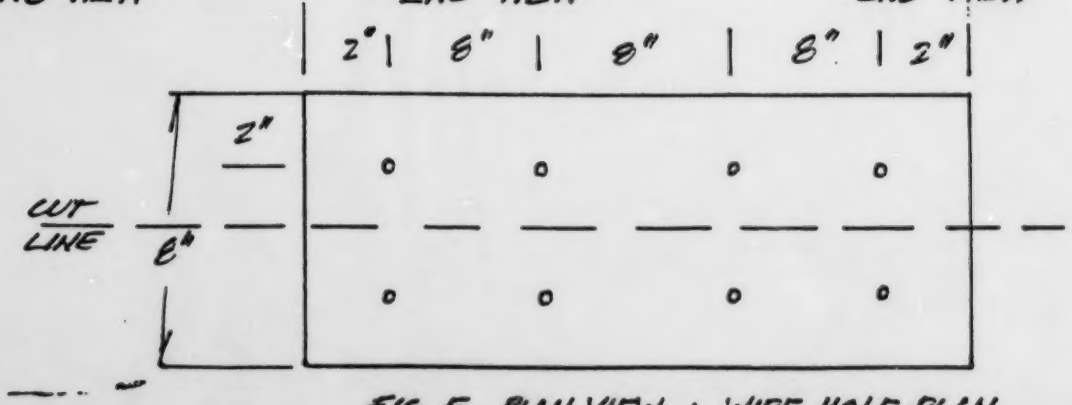


FIG. E · PLAN VIEW · WIRE HOLE PLAN

(Shepherdia canadensis)
SOAPBERRY (Fruiting)

Research:

Consultant:	Nancy Turner, Ethnobotanist
Photographs:	Nancy Turner, Bob Turner, Donna Warren
Collecting Site:	Malahat Look-out above Bamberton line, North upper side
Collecting Time:	July - September 1982. Was collected in late September. No evidence of berries July - September 1983 Debbie Bates, Donna Warren
Colour Sketches:	Donna Warren
Model Maker:	Donna Warren
Berry Maker:	Buddy Williams, Donna Warren
Techniques:	Donna Warren

Shepherdia canadensis
Soapberry (Fruiting)

Fieldwork

- Choose a "star" for the prototype for the model.
- Document well photographically (general views and details).
- Collect the "star" and document leaf sizes and numbers.
- Collect a selection of branches with similar leaf sizes to the "star."
- Execute a colour sketch.

Preservation

- Preserve the "star" using Queen's University preserving formula 16T8.

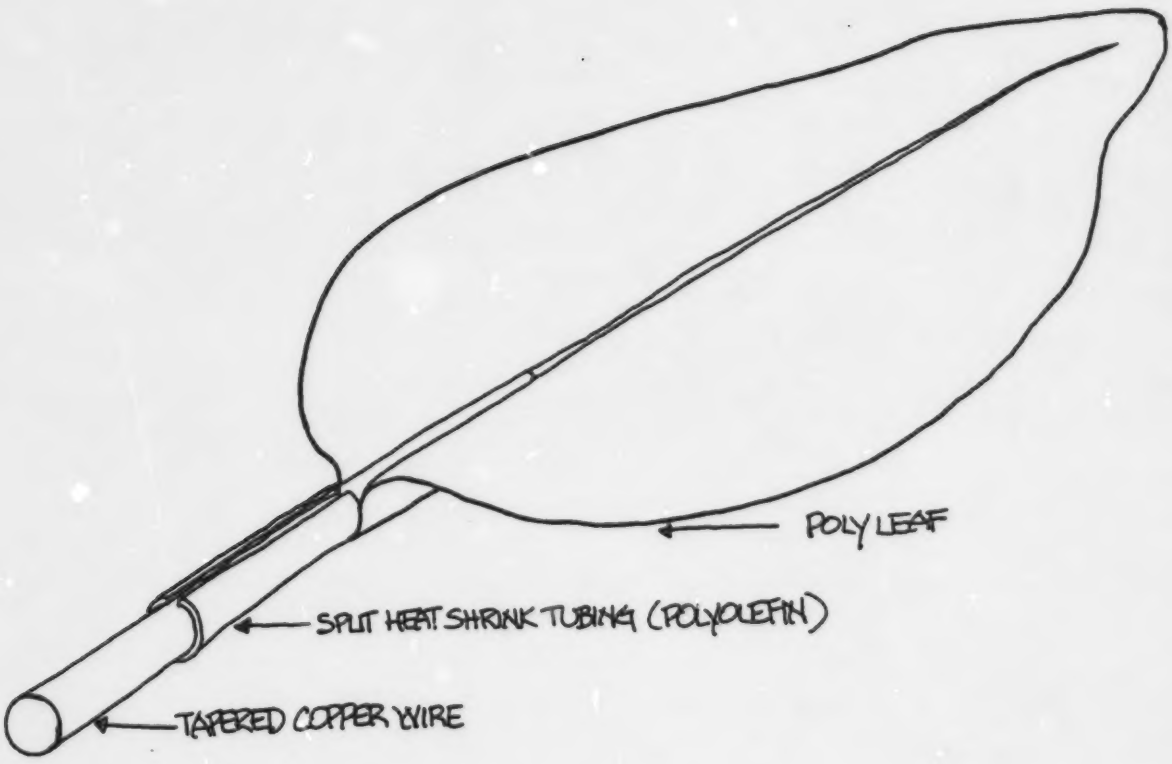
Leaves, Petioles and Blades

Leaves

- Snip appropriate fresh leaves from collected specimens.
- Use method #2 (see impression methods) and produce leaves in 6 mil. polyethylene. Make double the number required, providing extra for experimental use.
- Using manicure scissors, cut the poly leaves from the vacuum-formed polyethylene sheets.
- When preserved, use branch with leaves attached as a template by laying it on a piece of styrofoam and tracing the outline of its leaves and branches on to the styrofoam. This enables one to keep track of the allocation of the poly leaves; placing them into the styrofoam between painting, and is invaluable when assembling.

Petioles and blades

- Cut and taper copper wires (see notes on wire tapering) (p. 93).
- For soapberry leaves, the wire extending on to the leaf blades from the petioles needn't be very long (the poly leaves, in this case, are self-supporting).



PETIOLE DETAIL
SHEPHERDIA CANADENSIS
SOAPBERRY

- The petioles of the soapberry have a little split or runnel in them. After experimenting a bit, the following method was used:

1. Cut lengths of 3/64" i.d. polyolefin heat-shrink tubing, slightly longer than the measurements taken, and cut diagonally at one end. See appendix.

2. From each piece of tubing, remove about a fifth of its circumference, lengthwise.

3. Place a piece of this tubing around a tapered copper wire, leaving an extension at one end for attaching to the blade of the poly leaf.

4. Heat-shrink the tubing to the copper wire by waving it over a heat- gun.

5. Repeat process until the required number of petioles are finished.

Attachment of the Blade

1. Have a poly leaf at hand.

2. Dip top end of wire, up to the petiole tubing level, into a pan of hot-melt glue, (Bostik sticks) and coat.

3. Reheat the glue on the end of the wire with a heat-gun. Then, very quickly and accurately position the wire on the blade of the poly leaf (the poly should overlap the tubing slightly to secure a smooth join) and pinch the terminal sides of the leaf to the glue on the wire.

4. Repeat process until required number of leaves are finished.

Painting

- Air-brushed oil paints and mineral spirits.

- All colours applied to front surface of the leaves.

- Base coat:
  - (Colour #1) Titanium White/Lemon Yellow/Bellini Blue (brush this colour into the runnels of the petioles to hide the wires)

- Build up colours with a spatter spray:
  - (Colour #2) Lemon Yellow/Permanent Green (deep)
  - (Colour #3) Permanent Green (deep)/Cadmium Yellow/Vermillion

Texture:

- Fill a spice bottle with Aerosil (especially tasty on steak). Make a shaker-top from polyethylene held to the bottle top with an elastic band. Pierce the poly top all over with a #00 insect pin.

- Spray Grumbacher Matte Picture Varnish over surface.

- Cover the leaf surfaces with Aerosil while the varnish is still tacky.

- Re-spray varnish.

- Air-brush with colours #2 and 3.

Veins:

- When the paint is dry, use an insect pin-pencil, (whose tip has been sanded to a round point and heated slightly) to incise the veins, through the paint and texture layers to expose the clear polyethylene.

- Paint veins a light yellow/green using acrylic paints and a 000 sable brush.

Finishing:

- Lightly spray Grumbacher gloss varnish onto top surfaces.

- Air-brush a very light coating of Alizarin Crimson over the leaves (this enlivens the green).

- Hand-paint veins with a very light coat of rusty-coloured oil paint (Cadmium Yellow/Bellini Blue/Alizarin Crimson).

- Shape leaves by waving them over a heat-gun.

Scurf

Materials and equipment

- real leaves (freshly picked)
- nail scissors
- wooden burnisher with a small rounded end
- scalpel
- tweezers
- Krylon spray glue

The undersides of soapberry leaves are covered with scurf. It is made up of bundles of white hairs and rust-coloured platelets and has a distinct pattern and distribution.

The following method is based on the availability of fresh leaves (preserved leaves can be used, but are much less effective).

- Gather fresh leaves that approximate the sizes of the polyethylene ones. It is impossible to match the exact leaf sizes, in which case, fitting bits and pieces of difference leaves is necessary, since the rust-coloured platelets are concentrated around the perimeter of the leaf and along the blade and petiole.

- Cut, fit and match bits and pieces of the undersides of real leaves to the underside of a poly leaf.

- It is most important to register the blade of the back of the real leaf with that of the fake one and to do the same registering with the edges.

- The edges of the real leaf have to be trimmed and refitted, etcetera.

- Spray Krylon spray-glue onto the underside of the poly leaf and petiole.

- Quickly adhere the real leaf undersides to the leaf and petiole (wrap a piece around the petiole).

- Burnish the entire surface of the real leaf with the wooden tool, pressing harder along the blade. Do not tear the real leaf-pieces.

- Starting at the base of the leaf, carefully and slowly, peel the real leaf-pieces from the poly, so that all that remains on the poly leaf is the scurf.

Preserved Branch Touch up colour of the woody parts with air-brushed oil paints.

Berries See attached report.

Assembly

Materials and equipment

- Dremel Drill
- water
- acrylic paints
- drill bit (as fine as a straight pin
- white glue and small brush
- tweezers
- styrofoam
- rusty scurf scraped from real leaves

- Anchor the preserved branch in styrofoam.

- Cut a preserved leaf and petiole from the top of the branch and have the poly replacement ready.

- Drill into the wood at the site of the removed leaf.

- Trim the wire of the poly leaf to a point and to match the length of the hole drilled.

- Hold the wire with tweezers at the junction of the petiole.

- Dip the wire in white glue.

- Insert the wire into the drilled hole and cover the join with watered-down white glue applied with a brush, and apply extra scurf to wet glue.

- When dry, adjust the attitude (use tweezers and be careful!).

- Repeat the process, working from top to bottom, until a level is reached where berries are to be attached.

Attaching berries

Process is basically the same as leaf attachment except that one has to be very careful to drill precisely. (Four or five berries may grow at one circumference.)

- Two kinds of stems were used for the berries. Bigger berries had tubing cut at an angle from which two wires extended. Cut one of these flush with tubing. Use the one remaining for insertion. Smaller berries had two wires extending from the berry (tubing would be too large). Cut one to desired length of stem, using second wire for insertion. Coat wires with white glue to build up a stem. Paint with acrylic colours, another layer of white glue and rusty scurf.

The above method is not the ideal way. Ideally, tapered wires of different sizes would have sufficed.

Installation

- Mount the angled plexi rod (with a pre-fitted runnel to hold the main stem) by screwing the base to the surface of the yew wood block (see photos).

- Cut base of branch to appropriate angle.

- Hold the branch in the runnel at desired position.

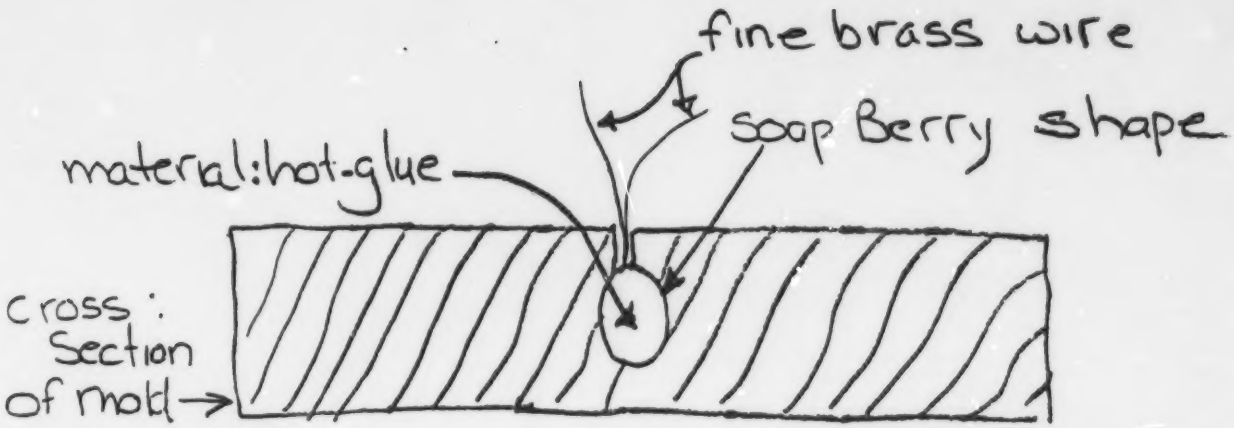
- Drill through the branch and runnel of plexi mount, parallel to the plexi base.

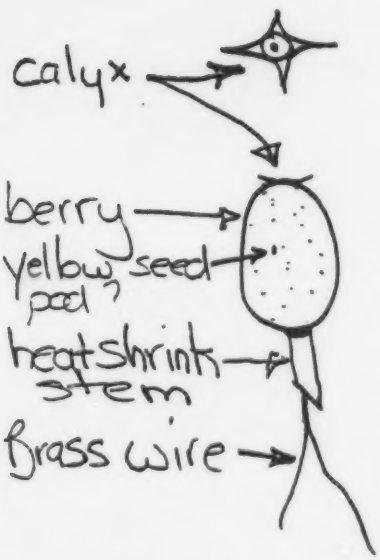
- Insert a length of a #000 insect pin through the two holes.

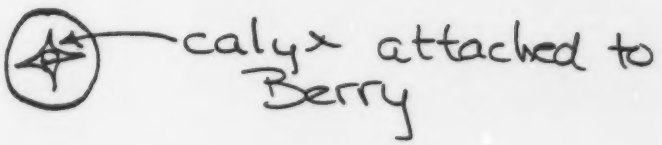
- Fill the hole on the stem surface with white glue topped with scurf.

- Lift the base of the stem and place a dot of hot-glue under it and to the surface of the wooden block. Trim excess away with a hot tool. Hide the join with acrylic paint.

- Touch up the woody stem, if needed, with white glue and scurf.


fine brass wire
soap Berry shape
material: hot-glue
cross: Section of mold


calyx
berry
yellow seed pod
heat shrink stem
brass wire


calyx attached to Berry

Soapberry
(Shepherdia canadensis)

Soapberries were sculpted out of Polyform (Sculpy). These berries were then baked to harden the model-making material. The material used to make the mold was RTV 700 with Beta 1 as the catalyst.

Once the rubber had cured, it was cleaned with I.P.A. 99% and then a material was selected to be used to reproduce the berries. Hot-glue was used, as it can be easily poured into a mold, has the translucency and "soft" look of berries, is much more durable a finished product and is ready in very little time.

Once the berries (hot-glue) were cured they were pulled from the mold and placed in a red dye (Hastings transparent liquid) overnight. The berries were then removed from the dye and towelled dry. This left the berries with a matte finish, so in order to achieve a gloss, the berries were individually heated with a hot air gun. The tiny yellow seed effect was achieved by applying the paint with a pin.

Real calyxes were removed from the collected soapberries and placed on the hot-glue berries by heating a pin and replacing the calyx into the heated end of the berry.

A final stem was added to the berries using heat shrink tubing over the fine brass wire.

SOAPBERRY FOAM

Research:

Consultant:	**Nancy Turner, Ethnobotanist**
	Food Plants of B.C. Indians
	by N. Turner
Photographs:	**Grant Hollands**
Collecting Site:	
Collecting Time:	
Model Maker:	**Doug Sage**
Techniques:	**Doug Sage, Donna Warren,**
	Pat Scott

Soapberry Foam

Technique

A mixture of one part acrylic emulsion to three parts micro-balloons gave the right viscosity for the foam to stand on its own. Ten percent of Benzoflex to the volume of acrylic was added to reduce shrinkage. Acrylic artists colour to suit, and wax chips coloured to simulate berry skins and pulp, were added. The mixed foam was ladled into a replica birch-bark basket that had been fumigated and distressed with a water diluted (approx. 10/1) potassium permanganate solution, and allowed to cure overnight. The cured foam was given two coats of vinyl sealer at 24 hour intervals to help prevent cracking and to give a bit of a glossy, wet look.

The finished basket of foam is mounted to its base by two wooden dowels into the bottom of the basket and base and held with hot glue.

Materials

- Dicker Marten 094 - acrylic emulsion
- Micro-balloons
- Benzoflex 9--88
- Dicker Marten 975 vinyl sealer.
- Bocour, Aqua-tec, Liquitex acrylic artist's colours

LABRADOR TEA (Ledum groenlandicum)

Construction techniques

The first step in the construction of the Labrador tea plant was the collecting of a few specimens of approximately the correct size for the display case and preserving them with the Queen's University formula. Colour sketches and photographs were taken at the same time.

After the preserving was completed, a preferred plant was selected for duplication. All the leaves of each of the three branches of the plant were counted, measured and separated into a year old leaf group and a new leaf group. From the numbers and measurements, a list of required molds was established. i.e.

The old-leaf group - 26 leaves total:

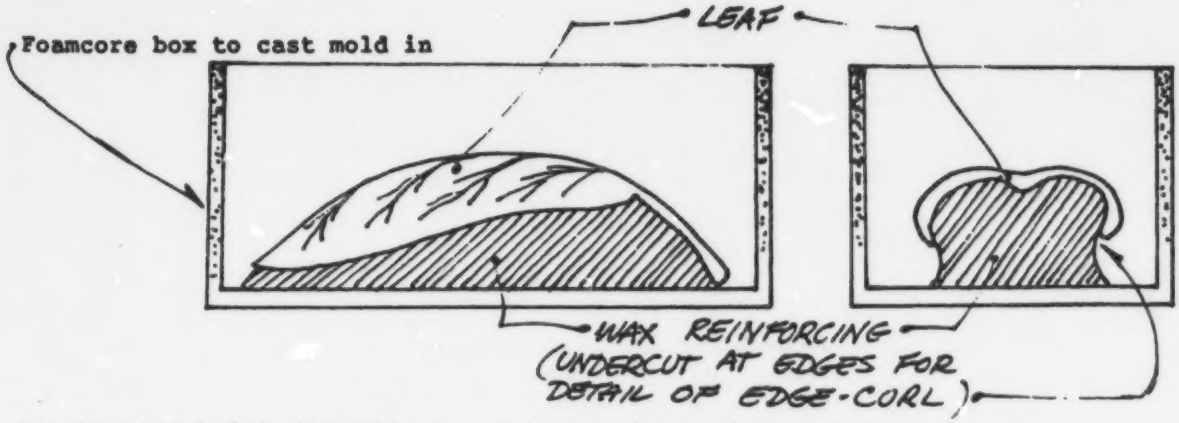
1 leaf	1 5/8 in.	Length
1 "	1 1/2 in.	Length
4 "	1 3/8 in.	Length
6 "	1 1/4 in.	Length
4 "	1 1/8 in.	Length
3 "	1 in.	Length
3 "	7/8 in.	Length
1 "	3/4 in.	Length
2 "	5/8 in.	Length
1 "	1/2 in.	Length

Mold list for the above group of leaves:

1 mold for leaves	1 5/8 and 1 1/2	
3 " " "	1 3/8 and 1 1/4	
3 " " "	1 1/8 and 1	
2 " " "	7/8 and 3/4	
1 " " "	5/8 and 1/2	

The same procedure was used for the twenty-eight new leaf group to complete a molds list.

For the leaf molds, fresh specimens were collected and individual leaves of the required sizes had paraffin wax brushed on their undersides to reinforce them so that they would retain their natural shape and curve in the molding process.



Dow Corning R.T.V. Silastic was used for the mold material.

To make the leaves in the finished molds, a mixture of approximately 50/50 Microsere and carnauba wax (colour to suit the natural leaves) was brushed into a mold in a thin layer.

Next, the wax was worked well into the mold using an inexpensive soldering iron plugged into a socket off a light dimmer-switch. This soldering iron set-up gives an adjustable heat range.

The next step was to work a wire armature, for attaching the leaf stem, into the wax and then a piece of fibreglass surfacing mat for re-enforcing was pressed into the wax with the soldering iron. More wax, as necessary, was brushed on and tooled with the soldering iron to finish filling the mat material.

After the wax had set, the leaf was removed from the mold and the edges trimmed with scissors and tooled with a wax spatula to finish the underside of the leaf.

All the leaves were cast and cleaned before brushing the undersides. On the new leaves, fine cotton batting was stuck on with vinyl sealer. For the old leaves, raw silk was dyed the appropriate colour then cut and attached with vinyl sealer.

The colour of the leaves was touched up with artist's oil paint and matte varnish as the final step to ready them for mounting to the stem.

The Stem.

The stem was made up of a wire armature coated with hot glue. The wire used for the armature was fairly stiff and stepped down in diameter as it progressed out to the thin ends. All the wire joints were about 3/8" long and filed flat to make strong solder joints.

Hot glue was applied with an ordinary hot glue gun and tooled with the adjustable temperature soldering iron to the required thicknesses and tapers. Varying marks and bark textures was achieved by varying the temperature of the soldering iron. The colour was done with artist's oils.

The leaves were attached to the stem by pressing the trimmed wire armature into the hot glue of the stem with the soldering iron. Wax was brushed on to fair the leaf-to-stem joint and then the final colour was touched up around the joints and the bug-bites, etc. The finishing touches of flocking and dead leaves on the stem were stuck on with vinyl sealer.

Materials

Matte varnish - Windsor & Newton Winton Matte varnish
Dow Corning R.T.V. Silastic
Microsere #5906 wax
carnauba wax
Bellini, Liquitex, Grumbacher artists oils
Weller WP 25 Soldering-iron
Dicker Martin 975 vinyl sealer
Raw silk
Silk dyes Seri Tint Liquid Dyes for silk or wool
Wholesale distributor:
Textile Artists Supplies,
5533 College Avenue,
Oakland, CA 94618
Bostik model 203 hot-glue gun

Labrador tea habitat

The habitat material was picked from Rithet's Bog in as intact a mat as possible. After drying and fumigation, a section of the mat, oversize for the display box, was laid on a piece of mesh and consolidated with a vinyl sealer and methyl hydrate (75/25) mixture by brushing and pouring in successive layers until all the material is fairly well held together and a mat of the vinyl sealer and mesh is from 1/2" to 1/4" thick. After allowing 4 or 5 days for the vinyl sealer to cure, the mat was trimmed to fit the size of the display base and sprayed with a matte finish to take away any sheen of the vinyl sealer.

The Labrador tea branch was mounted in the habitat with hot glue into a metal stud bolted into the plywood base of the display box.

BEARBERRY (Arctostaphylos uva-ursi)

Research:

Consultant:	Nancy Turner, Ethnobotanist, C. Cox, Botanist
Photographs:	Grant Hollands
Collecting Site:	High up off Durrance Lake Road, Victoria, B.C.
Collecting Time:	March, 1982
Personnel:	B. Williams, P. Scott, D. Sage, D. Warren, G. Harper

Bearberry in habitat

Bearberry was collected intact in its moss habitat from the Durrance Lake area, and the whole was preserved and then dried.

Leaves

Loose twigs of bearberry were extracted to simplify painting. All stems were painted to a natural colour using acrylic paints. Each leaf received an undercoat of white acrylic paint, top and bottom, and three or four coats of green acrylic paint were applied to each leaf surface (a darker green for tops, lighter green for the undersides). Buds, bug-bites, and dead areas were coloured with acrylic paints.

Berries

Berries were hand-formed on the heads of bug pins out of Sculpy, baked to harden, then immersed for 14 - 18 hours in unadulterated red, transparent polyester dye. The pins were removed, and twisted 6-strand fine, brass wire stems were attached with hot-melt glue, with some glue being worked with a hot tool to form calyxes and to cover the stem wires. The berries were then dipped in, or painted with, vinyl sealer, and the gloss was cut down with Pro-tecta-cote Matte Lacquer Spray. The stem wires were wrapped around the preserved stems at appropriate junctions, and hot-melt glue was worked with a hot tool to cover the wires and complete the stems of the berries. The stems were then painted to a natural colour with acrylic paints.

Habitat

The entire habitat was placed in a tray of rhoplex (approx 1/4" deep) and the rhoplex was allowed to soak up into the dirt/root mass and dry. The consolidated habitat was then cut to final size and shape with a large knife.

Main stems and roots of the bearberry were fixed in position with wires pushed through to the bottom of the mass and tied. The loose twigs were also re-attached into the habitat with wires and/or vinyl sealer, and mosses and/or lichens were arranged to cover up any visible wires. Loose bits of moss or lichen were fixed in place with vinyl sealer injected at the base of the plant by hypodermic needle, and the whole upper surface of the mass was liberally injected with vinyl sealer just below the visible flora.

Colour

The mosses and lichens were hand-painted with a mixture of transparent polyester dyes in a base of 50/50 methyl hydrate/vinyl sealer with a little white oil paint mixed in. Two or three coats were applied and allowed to soak in to achieve final colour.

LICORICE FERN AND HABITAT (Polyopdium glycyrrhiza)

Research:

Consultant:	Nancy Turner, Ethnobotanist
Photographs:	Carol Christianson, Grant Hollands
Collecting Sites:	Gillespie Road, Sooke (for moss and preserved ferns), Tyee Road, Esquimalt, Victoria
Collecting Time:	1982 for preserving and April 1983
Colour Sketches:	None
Model Maker:	Carol Christianson
Techniques:	Carol Christianson, Donna Warren

Licorice Fern and Habitat

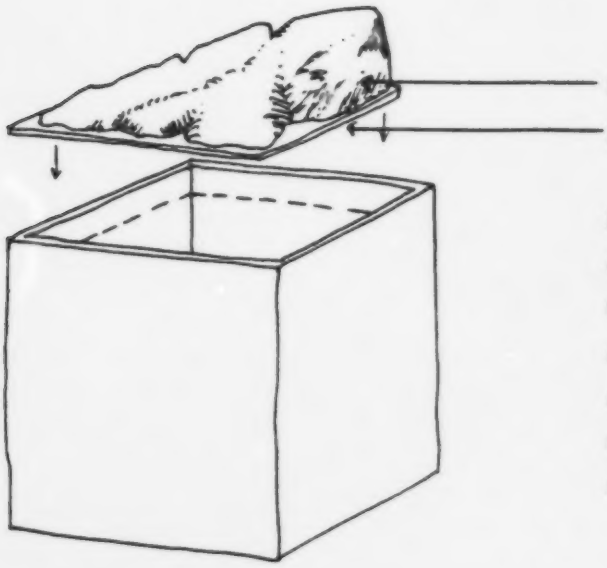
Rock

To make a latex casting rubber mold of a real rock - paint casting rubber onto real rock until all detail is filled. Allow to dry thoroughly between coats. Reinforce with 4" square pieces of latex-soaked cheese-cloth first then 4" squares of latex-soaked burlap. Finish with a final coat of rubber only. No jacket is required for a mold of this size.

Remove mold from rock. Paint with one gelcoat, thin enough to run into all detail. (Gelcoat is commercially manufactured and is catalysed with MEKP, or you can make it with a mixture of polyester resin, micro-balloons, aerosil, and MEKP.) Repeat above using slightly thicker gelcoat until a smooth layer fills all details.

When gelcoat has hardened, paint on one layer of resin/MEKP mixture. While resin is still wet, begin lay up with fibreglass and resin/MEKP. A couple of coats of glass will be adequate for a rock this small.

Installation - Cut fibreglass rock on a band saw, so that it fits into habitat frame. Piece together crevice for larger ferns, and any other modifications to rock shape, by using those bits that have been cut off. Glass rock together in its modified form. To patch cracks and visible fibreglassed areas, use polyester putty (polyester resin, MEKP, aerosil and microballons). Using a small putty knife or similar tool, apply and shape putty into rock texture. If putty hardens before shaping is completed, use a small chisel. Cut a piece of 1/8" plywood to fit snugly into frame. Insert rock into frame and mark its bottom outline as accurately as possible onto the plywood. Remove rock and plywood from frame and, using guidelines, place rock onto plywood again. Where possible, glass into place from underneath - otherwise, use hot-glue.



Fibreglass rock attached to plywood frame.

Base drops into frame to level of dotted line inside. There is a wooden platform inside the frame at this level. The rock base is screwed onto this platform from underneath, inside the habitat frame.

Rock painting

Cover with a thin layer of white enamel spray paint - just enough for a base coat. For colours use oil paints and turpentine in various dilutions depending on intensity desired. Allow to dry completely then give final tint with a thin olive/ochre oil wash. Spray lightly with matte damar varnish. When varnish is dry, dust rock with a small amount of plaster or silica powder (talc). Brush most of the powder off leaving some of the texture without the chalky appearance. Spray lightly again with matte varnish to fix the dust in place.

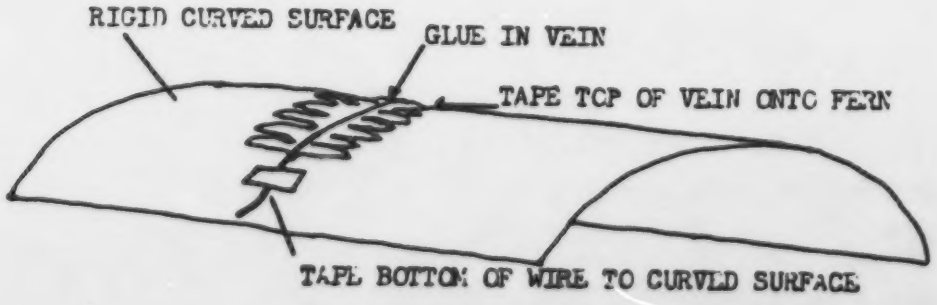
Plant Preparation

Licorice Ferns

Vacuum-formed from real ferns in 6mil polyethylene. Main centre vein, large leaf veins, and tiny leaf veins should all be picked up in the polyethylene. Leave real ferns in place on plastic. The edges of the leaves will be much easier to see for cutting out. Use a sharp scalpel when cutting out ferns. Remove real ferns but keep them for reference.

Taper appropriate lengths of copper wire for centre veins and stems by dipping in nitric acid. Check real leaves for correct thickness and taper of veins for individual ferns. Length depends on habitat into which ferns are to be installed - longer stems in thicker moss or deeper rock cracks.

Glueing veins. Use a curved surface when glueing. (See instructions for making holt-melt/turp glue p. 12. This was the only glue we found that would adhere to polyethylene.) Very carefully but liberally, paint glue into main vein. Lay fern over curved surface. Tape thick end of wire vein below bottom of fern and pull rest of vein tightly into place along vacuum-formed impression. Tape top of vein. Glue dried quickly so this must all be accomplished within a couple of minutes if the wire is to adhere. See diagram for taping. Paint more glue over and around sides of vein. Allow a couple of hours to dry thoroughly. Remove tape carefully. This glue works on polyethylene but is still very fragile and vein could detach quite easily if stressed. Touch up glue where tape was removed from top of vein.



Shaping Ferns. Heat needle tool in a bunsen burner flame. Carefully touch edges of individual leaves to curl and waver. Without this step, ferns would look flat and plastic.

Where detail has not been picked up clearly enough in the vacuum-forming process, use a small, blunt needle tool (not heated) and gently emboss veins into the polyethylene (topside of fern). This will curl fronds inward such that they will appear to be unfurling. Use this method especially for small ferns.

Painting larger ferns. Use oil paints diluted with turpentine. Colours applied (air-brushed) from lightest to darkest are:

1) white (front & back)
2) green/yellow (front only)

Hand paint all (except for main vein) red-green (including very tiny veins)

3) yellow/green (front only)
4) green (front & back)

At this step in painting, hand paint, in appropriate colours, the main vein and repaint main leaf veins only (not tiny ones). Keep in mind that the final spraying of red will 'pink up' vein colours. Minimal touch-ups to veins may still be necessary. Vein colours vary with sizes of leaves and the amount of sun they receive.

5) very dilute alizarin crimson (front only)

Light coats of matte damar varnish can be sprayed between coats of paint to speed the drying process

Painting small ferns. Once again, use oil paints diluted with turps. Air-brush white front and back . Air-brush green-yellow front and back. Hand-paint all main veins and any prominent smaller ones (medium green). Air-brush yellow-green front and back. Touch up veins. Finish with a light spray of gloss damar varnish. I used some alizarin crimson in very small amounts on some ferns but the real small ferns seemed to be fresher-looking and a brighter green.

Stems. Use white enamel spray paint on larger ferns. Hand-paint correct finished colour with acrylic paints. For smaller ferns hand-paint stems with acrylic paint after installing. Copper colour of wire is almost acceptable in cases where veins have more red in them.

Moss. Collected from a site in Sooke where licorice ferns are commonly found. Moss is preserved by spraying Queen's University Plant Preservative. It can also be soaked by spraying a solution of glycerine and water until tissue is saturated - as long as possible. Once preserved, colour of mosses will have been altered. Paint by hand with a solution of silk dyes and glycerine. Allow exterior to air-dry before installing.

Lichens. Carefully remove from rocks with a small palette knife or similar tool. Paint on liberally a mixture of glycerine and water. Allow to soak for as long as possible. Use a blotter to dry. Remove all excess glycerine solution being careful not to damage the lichens. Where necessary, hand-paint appropriate colours using either oils or acrylics. (The trick is care in application - not the type of paint used.) If lichens have darkened drastically during the preserving process, begin colour correction by air-brushing entire lichen white or very light base colour. Use oils whenever air-brushing.

Installation. Decide in detail what the finished habitat is to look like, taking into consideration all other aspects of the showcase and maintaining consistency with all other components within the Wild Harvest exhibit. Position moss, lichens, and ferns until exact placement is worked out. Glue down moss with white glue except where large ferns are growing. To install large ferns, use a dremel tool and a very small drill bit (same gauge as wire used for ferns stems - object is to friction-fit fern stems into holes) to drill holes into fibreglass rock. Remove fibreglass dust from rock. One fern at a time, apply hot-glue to stem and quickly insert into hole while glue is still hot. Apply some more glue around base of stem to anchor firmly. Once all large ferns are glued into place, replace moss around them and glue down with white

glue. Apply white glue to base of small fern stems and insert into position in moss. Make sure that enough of the glue comes into contact with moss so that ferns adhere firmly. Bend ferns into final position for drying. Glue lichens on with white glue - press edges tightly against rock so that they do not lift. A faster drying glue may be necessary if lichens are still oily from glycerine.

When habitat is dry, insert into frame. Plywood frame drops down onto frame false bottom. It is then screwed into place from underneath and can be easily removed for repairs, etc., by removing these screws.

Showcase #6 - Drying Rack

Research:

Consultant:	**Nancy Turner, Ethnobotanist**
Photographs:	**Nancy Turner**
Collecting Site for Huckleberries:	**Malahat and Shawnigan Lake**
Collecting Time:	**September 15, 1982 (very few berries)**
Colour Sketches:	**Laura Hargrave**
Model Makers:	**John Smyly - Drying rack** **Arlene Otke - Tule mats, cedar mats** **Alfred Ambers - Cooking box** **Nancy Flett - Salal cakes, Dried foods, Cedar basket** **Buddy Williams - huckleberries, huckleberry mush, habitat**

Wild Harvest - Showcase #6

Materials and equipment

- potassium permanganate
- turpentine
- waxes
- paint brushes
- paper towels
- palette knives
- alcohol lamp
- slides
- reference books
- fresh huckleberries
- asst'd jars, cups & buckets
- Licorice fern leaves (preserved)
- electric drill and bits
- asst'd hand made specialty tools
- cedar bark
- raffia grass
- wood
- power tools
- methyl hydrate
- oil paints
- mineral spirits
- RTV 700 A & B
- mixing sticks
- spatulas
- heat-gun
- slide projector
- prints (picture)
- colour sketches
- garbage container
- copper and brass wire
- I.P.A. 99%
- wire cutter
- RTV 615 A & B
- tule reeds
- transparent dye
- hand tools
- vinyl sealer

Transparent Dye (Huckleberry mush) for polyester resins:

Fritzgerald Enterprises,
Oakland California,
94606

RTV 615 A & B (huckleberry mush), RTV 700 & Beta (huckleberry mold):

Coast Fibretech,
1306 Boundary,
Vancouver, B.C., Tel: 294-8116

Transparent Dye (Soapberries):

Hastings Plastics,
1704 Colorado Avenue,
Santa Monica, Calif.
90404

Red Huckleberry (Vaccinium parvifolium)

Red huckleberries were collected and separated from stems and debris and left to air-dry while the casting mold-rubber was prepared. RTV 700 was used for the mold material because of its tear-strength and fast curing time (12 to 24 hours). Five 1 quart buckets were used to support the liquid Silastic RTV while it cured. The berries were placed with bug pins in the bottom of the five buckets.

RTV 700 was used with Beta 1 as the catalyst after mixing the two-part rubber and vacuum-chambering it. The rubber was poured over the berries and left overnight to cure.

Finished molds were removed from the buckets and the berries removed from the cured rubber. The molds were then cleaned with I.P.A. 99% and left once again to air dry.

Wax was selected as the material to reproduce the berries. Paraffin and microsere were the two waxes used; 60% paraffin to 20% microsere by weight. This gives a semi-transparent, hard berry with good detail and a melting point of about 130 degrees F., which is very important in an encosed case, as heat is a problem.

Wax was heated in a metal pot immersed in a pot of water on a hot plate to maintain an even heat of 200 degrees F., allowing ample time to work the wax before it set up. The main colour for the berries was Cadmium Red with a little Chinese Red and a dab of Geranium Lake for zest. All the colour added to the wax was oil paint. About 1,000 or more berries were cast in these molds, varying the colour to allow the berries not to blend together. A few berries were also cast to look a little on the ripe side.

After removing the cast berries from the mold, many were hand-tooled and painted to bring out more detail to the calyx. The berry stems were made from fine copper wire and hand-dipped in a wax that was tinted Cadmium Yellow. This was dipped several times to give the tapered effect required on a stem.

The stems were then placed in the berries. This was accomplished by first heating a needle that was fitted with a handle over an alcohol lamp, then melting a pin size hole in the berry, and, while the wax is still liquid, placing the wire stem in the berry.

All the berries were placed in the basket on top of a piece of styrofoam that was used to create the false bottom. The styrofoam was secured to the basket with tie wraps that would later also be used to secure the basket to the drying rack. The berries were attached to one another by means of heating a 1/2 inch piece of #6 guage music wire, placing it in the berry. Then once again using the needle with the handle to bore a hole in the berry you wished to rest against, already in the basket, you secured the two berries together again and again, etc. etc.

Berry Leaves

The leaves used in the scattered debris in the collecting basket are preserved licorice fern leaves. Huckleberry leaves were laid over them, traced and cut out. They were then lightly painted to match the greener colour of the huckleberry leaf. About two dozen leaves were cut and placed in the basket along with stems and twigs.

*All of these items had to be fumigated: carried out by the Conservation Division.

- cedar mats
- cedar stakes (for a drying rack)
- berry cakes
- tule mats
- Black tree lichen balls
- cedar basket
- camas bulbs
- tree lichen
- Black tree lichen

Huckleberry Mush

The Huckleberry mush was made from RTV 615 A & B and crushed dried huckleberry debris. About one pound of berries were collected, crushed and dried naturally. While these berries were air drying, the cooking box was prepared. After a little distressing of the box with sand, soil and wood stain, a false bottom was prepared. Some 3" from the top, a bottom was constructed and made liquid tight, as the RTV 615 had to be poured into the box to set up. After the berries had dried, all the debris was separated, keeping only the seeds and star shaped calyxes.

Mixing up 300 grams of RTV 615 A, I was ready to do the first of five pours. After mixing up the RTV 615 A & B, I then added several drops of Fritz Transparent Dye to the RTV 615. I used several drops of red and magenta to each of the five pours. After pouring this mixture into the box, I sprinkled some of the seeds and calyxes over the complete surface. RTV 615 takes several days to cure at room temperature, so I placed a 100 watt light bulb over the box to speed the cure time to about 4 hours. I repeated this procedure for the next three layers and on the fifth and final layer, just before it cured, I shifted the box about, to give a little ripple to the surface of the mush.

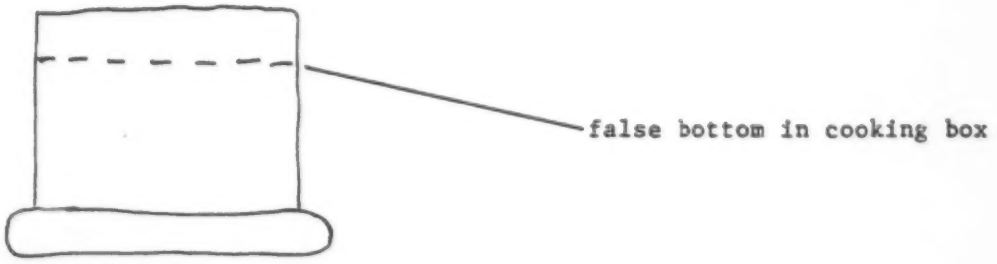
Drying Rack

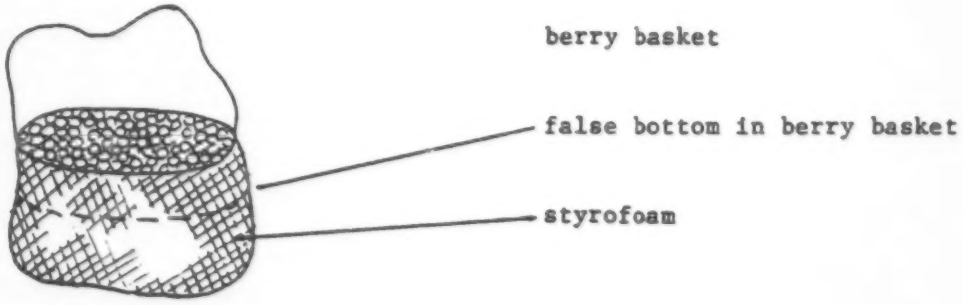
All the food stuffs on the drying rack are natural food stuff and were naturally prepared. Consolidating of the camas bulbs, and berry cakes were done with a hot-glue gun, the dried tree lichen was just wire with nylon line and the tree lichen balls were consolidated with vinyl sealer and methyl hydrate 50/50 base.

The cooking box was attached to the drying rack with screws. The basket was attached with tie wraps and the cedar matt and tule matt with brass wire. The rack itself was attached to the 'y' branches with #4 1 1/2" screws and the holes filled with hot-glue and coloured to match the bark of the cherry branches. The 'y' branches supporting the drying rack are just screwed through the bottom to secure them to the base of the case.

The cedar mats and basket were new and had to be somewhat distressed to give a little more of an aged look. This was achieved by applying several coats of potassium permanganate by brush to the whole area and spotting some of the area to give it an uneven distressed look.

The drying rack was given an aged look by applying a wash of mars black oil paint that had been thinned with mineral spirits; several washings of this and a hand rubbing with a little dirt (soil) gave the drying rack an aged look.





Showcase #6 - Habitat

A site was selected at Island View Beach to be reproduced as the habitat for under the drying rack. After placing a mock-up box in the sand and putting in the four dowels that would simulate the legs of the drying rack, the mock-up was photographed.

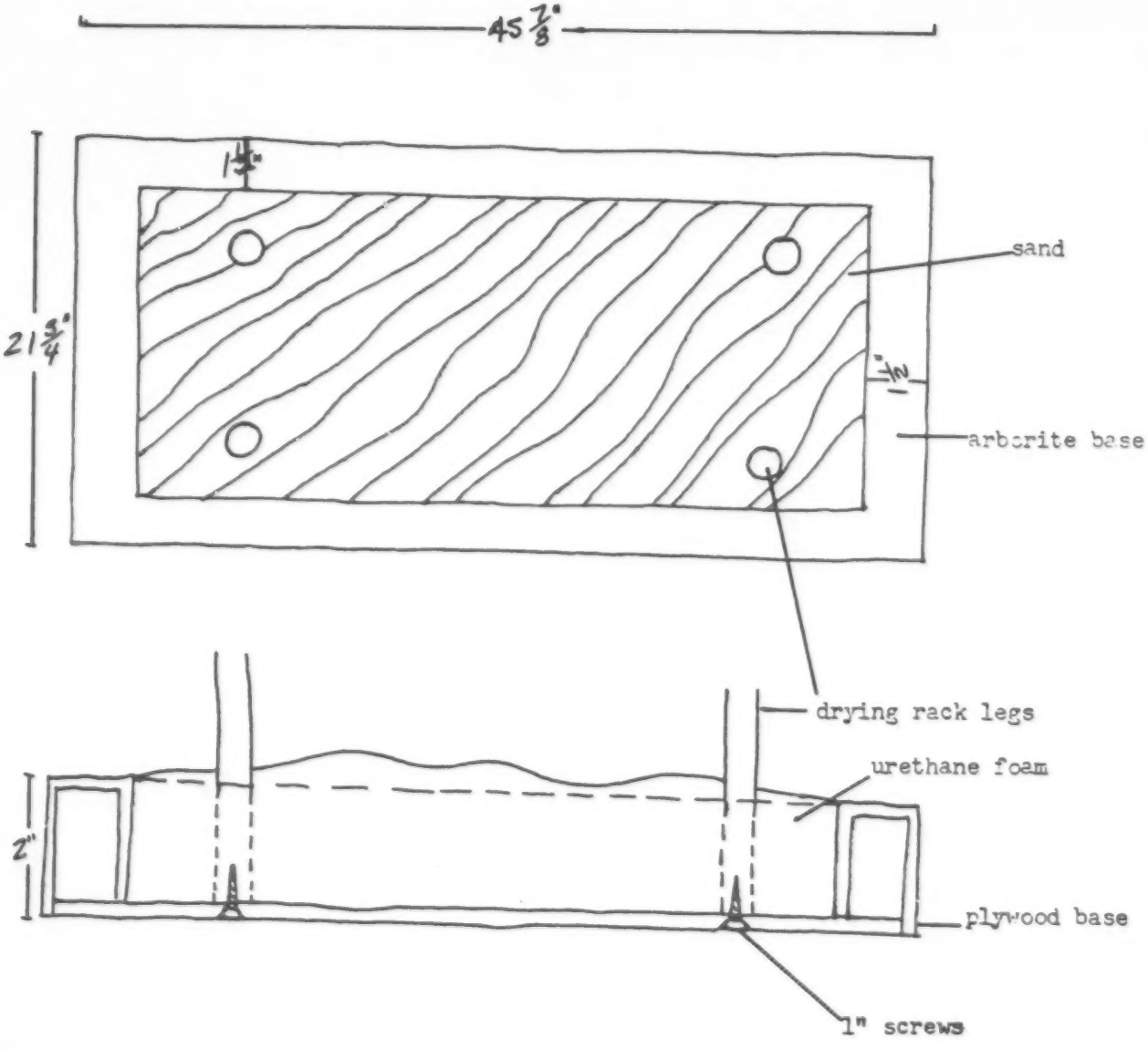
After collecting enough sand and beach debris, all the materials were taken to the museum work shop. The materials that were to be used in the habitat were placed in metal containers and baked in the oven at a temperature just below their flash point for four to five hours. This is a good form of fumigation and requires only an ordinary kitchen oven.

A base was made for the showcase #6 leaving the centre hollow. A piece of urethane foam was then cut to fit snugly into the hollow space. Urethane foam was selected as a base for the sand habitat because of its lightness, easy to shape ability, and of its compatibility with polyester resin, which would be used to adhere the sand to the foam.

Once the sanding and shaping of the urethane foam was completed, it was glued into the wooden base with polyester resin. A coat of resin was also applied to the surface of the foam to give it a hard crusted surface in the event anything was dropped on it. After the resin had cured, another coat was applied to the surface and then a layer of sand was sprinkled over the resin. This was repeated twice to give a full covering of sand and stones to the foam.

The drying rack was then placed on the finished sand and the leg positions were marked. The rack was set aside while holes were cut to accommodate the legs. These holes were cut oversize, puttied with polyester resin with microballoons to give a falling-in look of sand around the legs of the rack. The rack was then placed back on the base and secured with 1" screws through the base.

DRYING RACK BASE



Leaf Impressions

Three Methods

1. Impressions are made by choosing appropriately-sized fresh or preserved leaves and placing them face-up on smoothed, individual clay mounds, 1/2" - 1" high (Plainsman 500 porcelain clay). (With a Mickey Mouse vacuum-former such as we own, the draw is very shallow and detail is reduced if the undulations in the clay are anything other than flat.) Anyway, this method is tedious and time-consuming , but okay if one needs to store impressions for future use. So, on with the method - it is necessary to lay the fresh leaf, gingerly, on to the clay mound. It is especially difficult to achieve this when dealing with young, unopened or half-opened leaves. Then, one places scalpel cuts (before laying it on clay) 1/2 or 3/4 into the veins on the front surface of the leaves to allow the leaf to open. When the leaf is on the mound, gently press the veins into the clay with a rounded-tip, wooden modelling tool. Next, gently press the fleshy area and the leaf edge so that the leaf is approximately 1/32" below the mean surface of the clay. Allow the clay to air-dry for 2 - 6 hours. * Very carefully peel the leaf away from the clay. Start by catching the petiole with a pair of tweezers and slowly peeling back. The detail in the clay can be augmented by carving.

   * Note: More work needs to be done on the clay types used and the subsequent firing. The choice of porcelain clay was made because, when air-dried, it is less brittle than other clays. But if it is bisque* fired; shrinks 12 - 15%, whereas other less hard clays shrink only 9%. The firing will completely fry the leaf, so - no muss, no fuss.
   * Bisque firing provides 90% of potential strength and vitrified firing 100% strength.

2. Place fresh or preserved leaves, face down on shallow clay mounds which have been preformed to approximate the shape and size of the leaf perimeter and undulations. It is always advisable to slope the sides of the mounds and to keep the mean height of the mounds consistent. These are considerations made for the vacuum- former. The more dips and variations on the platen, the less chance of consistent detail in the product. Vacuum-forming can take place as soon as enough impressions are acquired to cover the platen. This method is limited by the fact that most impressions will have to be thrown-out when the leaves dry.

3. Place fresh or preserved* leaves face down, directly onto the felt platen of the vacuum-former. This is definitely the most successful method for reproducing detail.

Of course, the resultant poly leaves are flat, but they can be shaped after cutting and gluing of the petioles, or after painting by folding the mid-rib and main veins as one would fold a fan, or in half for ovate leaves. Folding the leaf in position and shape by running the leaf over the nozzle of a heat-gun (which is stationery with the nozzle perpendicular to the work surface). The rule is - if the heat is too much for your hand, it is too hot for the poly - and will wipe out detail, along with frying your pinky holder.

* Make sure preserved leaves are not gucky - pre-deguck them between layers of paper towels.

The three methods described use:

- **real leaves (fresh or preserved)**
- **4 - 8 mil. polyethylene sheet**
- **Nail scissors or mat knife (for cutting out leaves)**
- **Vacuum-former**

Tapering Copper Wire

Equipment and Materials

- nitric acid
- Pyrex cylinder or beaker (choice dependent on wire lengths)
- chemical resistant gloves and apron
- Scott cartridge full face respirator, Model #652L and Scott filter #6420A (acid gas vapour, organic vapour)
- fume hood
- water
- steel wool
- copper wire
- Draeger Kit w/No. fume detection tubes: nitrous fumes 0.5-A (o.5 - 10 ppm, Ref. # CH 29401); No_x 0.5-C (0.5 - 10 ppm, Ref. # CH 3001)

Method

- Cut wires 3 times the desired finished lengths and loop in half.
- Clean wire using steel wool and water.
- Dry the wire.
- Pour nitric acid into container two-thirds the level of the length of the wires (allows one to retrieve the wires without ferreting around in the acid).
- Immerse the wires into the acid. (When immersing several wires at once, do not have any of them touching or crossing one another. This would result in the taper not being smooth.)
- Dip the wires in and out of the acid to facilitate oxidation. The reaction can be quite violent at times, depending on the ratio of copper to nitric acid and how saturated the acid is with by product from previous use. (Very pretty crystals of $CuNO_3$ form as sediment.)
- Check No_x (nitrogen oxides) levels in the air with the Draegar. Tlv = 5ppm.
- When the desired taper is achieved, wash and scrub the wires with water and steel wool.

N.B. This process is very dangerous. Hydrogen monoxide (HO) combines in air to form NO_2 (one of the most insidious gases).

Please read the attached information before using this method for wire tapering.

No_x References attached:

Nitric acid Nitric oxid Nitrogen dioxide	Merck Index
Nitric acid Nitric oxide Nitrogen dioxide	Sax
Nitrogen dioxide Nitrogen oxides	Fundamentals of Industrial Hygiene
Critical Literature Review of Nitrogen Dioxide	Patty's industrial.

THE MERCK INDEX

AN ENCYCLOPEDIA OF CHEMICALS AND DRUGS

NINTH EDITION

6393 Nitric Acid

Aquafortis: Salpetersaure (German).
HNO_3; mol wt 63.02. H 1.60%, N 22.23%, O 76.17%.
Usually produced by the catalytic oxidation of ammonia.
Reviews of industrial processes: F.D. Miles, Nitric Acid, Manufacture and Uses (Oxford Univ. Press, 1961, 1963); W. Sommer in Ullman's Encykopadie der technischen Chemie vol. 15, pp 3-67 (3rd ed., 1964); Strelzoff, Newman in Kirk-Othmer Encyclopedia of Chemical Technology vol. 13 (Interscience, New York, 2nd edition 1967) pp 796-814.
Purification by distln: Briner et al., Helv. Chim. Acta 18, 376 (1935); Ward et al., Inorg. Syn. 3, 13 (1950); Kaplan, Schechter, ibid. 4, 52 (1953).
Reviews: Several authors in Mellor's Vol. VIII, supplement II, Nitrogen (part 2), 278-352 (1967): Jones in Comprehensive Inorganic Chemistry vol. 2, J.C. Bailar, Jr. et al., Eds. (Pergamon Press, Oxford 1973) pp 375-388. See also Nitric Acid, Anhydrous.

Colorless liq. Fumes in moist air. Characteristics choking odor. d 1.50269. mp -41.59°. Monohydrate, mp -37.68°. Trihydrate mp -18.47°. Heat of fusion: 2.503 kcal/mole. Heat of infinite dilution ($298.1^{\circ}K$): -7971 cal/-mole. bp_{760} 83°. With water it forms a negative azeotrope (min vapor press. max bp), so-called constant boiling acid at 68% HNO_3, bp 120.5°, d20/4 1.41. The oxide-free acid, diluted with an equal vol of water, does not discolour drops of 0.1N $KmnO_4$. Colorless 100% acid cannot be stored in the presence of light without formation of NO_2 which

produces the discoloration. Stains woolen fabrics and animal tissue a bright yellow. In the presence of traces of oxides it attacks all base metals except Al and special Cr steels which become passivated. Strong, monobasic acid. Oxidizing agent. Reacts violently with alcohol, turpentine, charcoal, organic refuse. Nitric acid concentrated is water soln contg 70-71% HNO_3. Density of aq solution: d20/4 1.0036 (1% HNO_3 w/w); 1.0543 (10%); 1.1150 (20%); 1.1800 (30%); 1.2463 (40%); 1.3100 (50%); 1.3667 (60%); 1.4134 (70%); 1.4521 (80%); 1.4826 (90%); 1.5129 (100%): International Critical Tables III, 58 (1928). See also Nitric Acid, Fuming.

USE: Manufacture of inorganic and organic nitrates and nitro compounds for feritilizers, dye intermediates, explosives and many different organic chemicals. Caution: Ingestion causes burning and corrosion of mouth, esophagus, stomach; abdominal tenderness, shock, death. Continued exposure to vapor may cause chronic bronchitis; chemical pneumonitis may occur. Carbonated alkalies must not be used as antidote in case of poisoning by ingestion.
THERAP CAT: Pharmaceutic aid (acidifying agent).
THERAP CAT (VET): Cauterizing agent (for warts).

6394 Nitric Acid, Anhydrous.

Prepared by distillation on concd nitric acid with concd sulfuric acid; by treating sodium or potassium nitrate with 100% H_2SO_4 and removing HNO_3. Review of preparation and properties of pure HNO_3: Stern et al., Chem. Rev. 60, 185-207 (1960). See also Nitric Acid.

Liquid: decomposes above freezing point to form NO_2, H_2O and O_2. Develops yellow color due to nitrogen oxide formation. mp -41.59°. d° (liq) 1.5492. Forms white, monoclinic crystals; d-41.6 (solid) 1.895.

6395 Nitric Acid, Fuming.

Defined as concentrated nitric acid containing dissolved nitrogen dioxide. May be prepared from concd nitric acid by passing nitrogen dioxide into it or by adding a small amount of organic reducing agent, such as formaldehyde.

Yellow to brownish-red, clear, strongly fuming, very corrosive liq; evolves suffocating, poisonous, yellowish-red fumes of nitrogen dioxide and nitrogen tetroxide. The density increases as the free NO_2 content increases: concd HNO_3 with 7.5% NO_2 added d20/4 = 1.526; with 12.7% NO_2 d20/4 = 1.544. Fuming nitric acid A.C.S. reagent has a density of approx. 1.5 and assays not less than 90% HNO_3 by titration with NaOH using methyl orange indicator. Miscible with water. **HANDLE WITH EXTREME CARE**

USE: In those organic reactions where nitric acid acts more as an oxidizing agent than as a source of hydrogen ions.

6396 Nitric Oxide

Mononitrogen monoxide; nitrogen monoxide. NO; mol wt 30.01. N. 46.68%, O 53.32%. Prepd industrially by passing air through an electric arc (basis of atmospheric nitrogen fixation) or by oxidation of ammonia over platimun gauze. Convenient lab procedure using sodium nitrite and ferrous sulfate: Blanchard, Inorg. Syn. 2, 126 (1946). Alternate lab methods: Schenk in Handbook of Preparative Inorganic Chemistry vol. 1, G. Brauer, Ed. (Academic Press, Oxford, 1973) pp 323-334.
Colorless gas. Burns only when heated with hydrogen. Deep blue when liquid. Bluish-white snow when solid. mp -163.6°. bp -151.7°. d-150.2 (liq) 1.27. d (gas) 1.04 (air = 1). Trouton constant 27.1. Contains an odd number of electrons and is paramagnetic. Crit temp -94°. Crit press. 65 atm. Heat of formation (18°): -21.5 kcal/mole. Heat of vaporization (bp): 3.293 kcal/mole. Solubility in water (ml/100 ml; 1 atm): 4.6 (20°); 2.37 (60°). Combines with (1) bromine to form the nitrosyl halides, such as NOCl, see N.V. Sidgwick, Chemical Elements and Their Compounds vol. I (Oxford, 1950) p 683. Usually shipped in steel cylinders as compressed gas at 480 lb/sq in.

USE: In large quantities in the manuf of nitric acid, also in the bleaching of rayon, as stabilizer (to prevent free-radical decompn) for propylene, methyl ether, etc. **Caution: Immediately on contact with air, nitric oxide is converted to the highly poisonous nitrogen dioxide, nitrogen tetroxide, or both. Gas masks plus adequate ventilation are mandatory when handling even small amounts in the laboratory.** See also Nitrogen Dioxide.

6425 Nitrogen Dioxide.

NO_2; mol wt 46.01. N 30.45%, O 69.55%. Prepd industrially from nitric oxide and air. Convenient lab prepn from lead nitrate: Schenk in Handbook of Preparative Inorganic Chemistry vol. 1, G. Brauer, Ed. (Academic Press, New York, 1963) pp 488-489. Ultrapure NO_2 from N_2O_5: Haskspill, Besson, Bull. Soc. Chim. France, Mem. (5) 16, 479 (1949). Reviews: Beattie, "Nitrogen Dioxide and Dinitrogen Tetroxide" in Mellor's Vol. VIII, supplement II, Nitrogen (part 2) 246-268 (1967); Jones in Comprehensive Inorganic Chemistry vol. 2, J.C. Bailar, Jr. et al., Eds. (Pergamon Press, Oxford, 1973) pp 340-356.

Reddish-brown gas. Liquid below 21.15°. Irritating odor. **DEADLY POISON!!** The commercial brown liq under pressure is called nitrogen tetroxide. Actually this is an equilibrium mixture of NO_2 d21.3 gas 3.3 g/liter. mp -9.3°. bp 21.15°. Crit temp 158.2°. Crit press. 99.96 atm. Heat of vaporization (bp) 9.110 kcal/mole. Does not burn, but supports the combustion of carbon, phosphorus, sulfur. Sol in concd sulfuric and nitric acids. Dec in water forming nitric acid and nitric oxide, reacts with alkalies to form nitrates and nitrites. Corrosive to steel when wet, but may be stored in steel cylinders when moisture content in 0.1% or less.

USE: Intermediate in nitric and sulfuric acid production. Used in the nitration of organic compounds and explosives, in the manuf of oxidized cellulose compds (hemostatic cotton). Has been used to bleach flour. Proposed as oxidizing agent in rocket propulsion. See also: Sisler, "Reactions in Liquid Dinitrogen Tetroxide", J. Chem. Ed. 34, 555 (1957). CAUTION: One of the most insiduous gases. Inflammation of lungs may cause only slight pain or pass unnoticed, but the resulting edema several days later may cause death. 100 ppm is dangerous for even a short exposure, and 200 ppm may be fatal: Y. Henderson, H.W. Haggard, Noxious Gases, A.C.S. Monograph Series, no. 35 (Reinhold, New York, 2nd ed., 1943) pp 124-137, 141.

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DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS

FOURTH EDITION

N. Irving Sax

VNR - VAN NOSTRAD REINHOLD COMPANY
New York Cincinnati Toronto London Melbourne

NITRIC ACID * 961

General Information

Synonyms: aqua fortis: hydrogen nitrate; azotic acid;
Transparent colourless or yellowish, fuming, suffocating, caustic and corrosive liquid.
Formula: HNo_3.
Mol wt: 63.02. mp: -42°C, bp: 86°C, d: 1.502.

HAZARD ANALYSIS

Toxic Hazard Rating:

Acute Local: Irritant 3; Ingestion 3; Inhalation 3.

Acute Systemic: Inhalation 3.

Chronic Local: Irritant 2.

Chronic Systemic: U.

Toxicology: The exact composition of the "fumes" or vapor produced by nitric acid depends upon such factors as temperature, humidity, and whether or not the acid comes in contact with other materials such as heavy metals or organic compounds. Depending upon these factors, the vapor will consist of a mixture of the various oxides of nitrogen and of nitric acid vapor. Nitric acid vapor is highly irritant to the mucous membranes of the eyes and respiratory tract and to the skin. It is corrosive to the teeth. Because of its irritant properties, chronic exposure to dangerous concentrations of the acid vapor seldom occur.

Fire Hazard: Moderate, by chemical reaction with reducing agents. It is a powerful oxidizing agent.

Explosion Hazard:

Slight, by chemical reaction to evolve NO_x; can explode on contact with powerful reducing agents.

Disaster Hazard:

Dangerous; when heated to decomposition, it emits highly toxic fume of NO_x and hydrogen nitrate; will react with water or steam to produce heat and toxic and corrosive fumes.

COUNTERMEASURES

Ventilation Control: Section 2.
To Fight Fire: Water (Section 7).
Personnel Protection: (Section 2).
Storage and Handling: Section 7.
Shipping Regulations: Section 11.
Regulated by CG.DOT.IATA

NITRIC OXIDE *

General Information

Synonym: NO_x.
Colourless gas; blue liquid and solid.
Formula: NO
Mol. wt: 30.01, mp: -161°C, bp: -151.8C, d: 1.3402 g/liter; liquid: 1.269 at -150°C.

HAZARD ANALYSIS
Toxic Hazard Rating:
Acute Local: Irritant 3.
Acute Systemic: Inhalation 3.
Chronic Local: U.
Chronic Systemic: Inhalation 2.

Toxicology: Exposure to such fumes may occur whenever nitric acid acts upon organic material, such as wood, sawdust and refuse; it occurs when nitric acid is heated, and when organic nitro compounds are burned, as for example, celluloid, cellulose nitrate (guncotton) and dynamite. The action of nitric acid upon metals, as in metal etching and pickling, also liberates the fumes. In high-temperature welding, as with the oxacetylene or electric torch, the nitrogen and oxygen of the air unite to form oxides of nitrogen. Exposure may also occur in many manufacturing processes when nitric acid is made or used.

The oxides of nitrogen are somewhat sol. in water, reacting with it in the presence of oxygen to form nitric and nitrous acids. This is the action that takes place deep in the respiratory system. The acids formed are irritants, causing congestion of the throat and bronchi, and edema of the lungs. The acids are neutralized by the alkalis present in the tissues, with the formation of nitrates and nitrites. The latter may cause some arterial dilation, fall in blood pressure, headache and dizziness, and there may be some formation of methemoglobin. However, the nitrite effect is of secondary importance.

Because of their relatively low solubility in water, the nitrogen oxides are only slightly irritating to the mucous membranes of the upper respiratory tract. Their warning power is therefore low, and dangerous amounts of the fumes may be breathed before the workman notices any real discomfort. Higher concentrations (60 to 150 ppm) cause immediate irritation of the nose and throat, with coughing and burning in the throat and chest. These symptoms often clear up on breathing fresh air, and the workman may feel

well for several hours. Some 6 to 24 hours after exposure, he develops a sensation of tightness and burning in the chest, shortness of breath, sleeplessness and restlessness. Dyspnea and air hunger may increase rapidly, with development of cyanosis and loss of consciousness, followed by death. In cases which recover from the pulmonary edema, there is usually no permanent disability, but pneumonia may develop later. Concentration of 100 to 150 ppm are dangerous for short exposures of 30-60 min. Conc of 200-700 ppm may be fatal after even very short exposures.

Continued exposure to low conc of the fumes, insufficient to cause pulmonary edema, is said to result in chronic irr of the respiratory tract, with cough, headache, loss of appetite, dyspepsia, corrosion of the teeth and gradual loss of strength.

Exposure to nitrous fumes is always potentially serious, and persons so exposed should be kept under close observation for at least 48 hours.

NITROGEN DIOXIDE *

General Information

Synonym: nitrogen tetroxide, NO_x, nitrogen peroxide.
Colourless solid to yellow liquid.
Formula: NO_2.
Mol. wt: 46, mp: -9.3°C (yellow liquid), bp: 21°C (red brown gas with decomp.), d: 1.491 at 0°C, vap. press.: 400mm at 80°C.

HAZARD ANALYSIS

Toxicity: Highly toxic. See nitric oxide.

Disaster Hazard: See NO_x.

COUNTERMEASURES

Ventilation Control: Section 2.

Storage and Handling: Section 7.

Shipping and Regulations: Section 11.

Regulated by CG, DOT, IATA.

FUNDAMENTALS OF INDUSTRIAL HYGIENE

SECOND EDITION

Julian B. Olishifski, P.E., C.S.P.
Editor-in-Chief

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1083

Nitrogen dioxide is the toxic constituent of the red fumes from nitric acid in contact with reducing materials and is also one of the toxic components of the welding fume produced in poorly ventilated areas. It is a lung-injurant gas which has inadequate warning properties so that a dangerous amount may be inhaled (resulting in lung edema) without great discomfort. In experiments with white fuming nitric acid, red fuming nitric acid, and nitrogen dioxide, the presence of nitric acid in the exposure atmosphere resulted in skin burns (which did not occur with the nitrogen dioxide) but had little effect upon the concentration required to produce death.

Rats, mice, and quinea pigs exposed for four hours per day, five days per week, for six months to 4 ppm of nitrogen dioxide showed no ill-effects. When similarly exposed to 9 and 14 ppm, they showed lung effects.

The safe level for short exposures is unknown, but 25 ppm is probably safe for a few minutes.

Atmospheric concentration immediately hazardous to life - 200 to 700 ppm is rapidly fatal.

A ceiling TLV was attached to the 5 ppm limit to minimize the risk of accelerating lung-tumour development. NO_2 is a free radical; one theory of tumorigenesis has free radicals as its basis.

NITROGEN OXIDES.

Nitrous oxide, N_2O, is a colourless, noncombustible gas, sweet tasting, and slightly soluble in water. Nitric oxide, NO, combines with oxygen to form nitrogen dioxide, NO_2, which is a reddish brown gas with a characteristic odor. Nitrogen dioxide exists in equilibrium with nitrogen tetroxide, and these two compounds and oxygen are in equilibrium with the crystalline nitrogen pentoxide, N_2O_5. However, nitrogen dioxide and nitric oxide are the dissociation products of nitrogen trioxide, NO_3. When nitrogen dioxide comes in contact with water, nitrous acid and nitric acid are formed.

Exposure to nitrogen oxides is typically a mixed exposure to "nitrous fumes" that may evolve from various manufacturing processes and in many other industrial situations. Exposure to nitrogen oxides may occur during the manufacture of nitric and sulfuric acid, oxidized cellulose compounds, explosives, rocket propellants, fertilizers, dyes and dyestuffs, pharmaceuticals and various other organic and inorganic chemicals such as nitrites, nitrates, and other nitro compounds, a regia, arsenic acid, oxalic acid, nitrous acid, phthalic acid, and phosphoric acid. Exposure may also occur during jewelry manufacturing, etching, brazing, lithographing, metal cleaning, textile (rayon) and food bleaching, glass blowing, electroplating, gas and electric arc welding, and during the nitration of chloroform. Nitrogen oxides also occur in garages from automobile exhaust, in silos from organic material decomposition, in tunnels following blasting, and when nitric acid comes in contact with organic materials.

Nitrogen oxide gases may produce irritation of the eyes and mucous membranes. Prolonged low-level exposure may produce yellowish or brownish staining of the skin and teeth; however, this sign usually indicates nitric acid exposure. Nitric acid and nitrogen tetroxide are extremely corrosive liquids and may cause severe burns, ulcers, and necrosis of the skin, mucous membranes, and eye tissues. Exposure to high concentrations of nitrogen oxides may result in severe pulmonary irritation and methemoglobinemia. The former is believed to be caused by nitric oxide. Typically, acute exposure may produce immediate malaise, cyanosis, cough, dyspnea, chills, fever, headache, nausea, and vomiting. Collapse and death may occur if exposure is sufficiently high. When lower concentrations are encountered, there may be only mild signs of bronchial irritation followed by a five to twelve-hour symptom-free period. Subsequently, the onset of signs and symptoms of acute pulmonary edema occurs suddenly, which unfortunately may take place away from prompt medical aid.

Nitrogen oxides may be formed from green silage in amount which, when restrained to the confines of a silo, may constitute a serious health hazard - "silo-filler's disease".

PATTY'S INDUSTRIAL HYGIENE
AND TOXICOLOGY
THIRD REVISED EDITION

Volume 1

GENERAL PRINCIPLES

GEORGE D. CLAYTON
FLORENCE E. CLAYTON
Editors

614

Table 14.4 Critical Literature Review of NO_2, 1961-1973

Reference	Publication Date	Country	Type of Study: Epidem.	Type of Study: Lab.	Exposure	Contaminents Measured
15	1961	U.S.		X	Controlled Exposure	NO_2
16	1962	U.S.		X	Controlled Exposure	NO_2
17	1963			X	Controlled Exposure	NO_2 and an aerosol of K. pneumonia
18	1964	U.S.		X	Controlled Exposure	NO_2 and carbon particles
19	1965	U.S.		X	Controlled Exposure	NO_2
20	1965			X	Controlled Exposure	NO_2
21	1965			X	Controlled Exposure	NO_2
22	1968 1969			X	Controlled Exposure	NO_2
23	1968			X	Controlled Exposure	NO_2
24	1969			X	Controlled Exposure	NO_2

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TABLE 14.4

Ref.	Concentrations[a]	Effects Studied	Effects Observed (Concentration)
15	1–50 ppm	NO_2 exposures on small numbers of volunteers	1–3 ppm Odor threshold 13 ppm Eye and nasal irritation 25 ppm For 5 min pulmonary discomfort 50 ppm For 1 min increased nasal irritation and pulmonary discomfort
16	0–104 ppm	Threshold concentrations for rats at various exposure times	Threshold concentrations based on borderline changes in lung to body weight ratios: 5 min, 104 ppm; 15 min, 65 ppm; 60 min, 28 ppm
17	0–3.5 ppm NO_2	Susceptibility of mice to K. pneumonia in presence of NO_2	2.5 ppm, no increased susceptibility; 3.5 ppm for 2 hr, doubled the mortality rate
18	100–1000 ppm NO_2	Effect of NO_2 on lungs of mice and carbon as a carrier of NO_2	250 ppm or greater of NO_2 alone, respiratory distress during and following exposure
19	5 ppm	Effects of continuous exposure of NO_2 for 90 days on 50 rats and 100 mice	5 ppm for 90 days: rats, 18% mortality; mice, 13% mortality
20	5–25 ppm	Intermitten exposures for 18 months on laboratory animals	5–25 ppm: no increased mortality no changes in body weight, hemoglobin values, or biochemical indices
21	5–15 ppm	Effect of NO_2 on the lung tissues of guinea pigs	Daily exposure of 5–15 ppm resulted in increasing titers of lung tissue serum
22	0.8–25 ppm	Effect of NO_2 on respiratory tract of rats	0.8–2 ppm, rats grew and survived normally; 4.0 ppm for 16 weeks, terminal bronchiolar epithelum was broadened and hypertrpohied; 10–25 ppm, developed large air-filled heavy lungs and died of respiratory failure
23	26 ppm	Effect on pulmonary function in lungs of dogs	26 ppm for 6 months, marked histophathologic changes in the lungs; however, 225 days after cessation of NO_2 exposure, no significant pulmonary function alterations
24	0–40 ppm	Effect on germ-free mouse lungs	40 ppm (6–8 wks), proliferation of epithelial cells of bronchi to form

TABLE 14.4 (Continued)

Reference	Publication Date	Country	Type of Study Epidem.	Lab.	Exposure	Contaminants Measured
25	1970	U.S.	X		Total Exposure	NO_2: suspended Nitrates
26	1970	U.S.	X		Total Exposure	NO_2: suspended Nitrates
44	1971	Japan	X		Total Exposure	SO_2, CO, NO_2, O_3, TSP
45	1972	U.S.		X	Controlled Exposure	NO_2, SO_2, CO, PbClBr
27	1972	U.K.	X		Total Exposure	NO_2, NO
28	1973			X	Controlled Exposure	NO_2
29	1973	U.S.	X		Total Exposure	NO_2
30	1973		X		Total Exposure	NO_2, CO, HC
31	1973			X	Controlled Exposure	NO_2

Ref.	Concentrations	Effects Studied	Effects Observed (Concentration)
24			multicellular membrane projecting into lumen; also increased epithelial cells in alveolar spaces
25	NO_2, 0.062–0.109 ppm: SN.3.8–7.2 ug m^3	Acute respiratory illness in families	0.062–0.109 ppm (24 weeks) 18.8% excess in acute respiratory illness in this range
26	NO_2,0.062–0.109 ppm: SN.3.8–7.2 ug/m^3	Pulmonary function in elementary school children	0.062–0.109 ppm (24 weeks), decreased pulmonary function in children exposed to high level of NO_2
44	Varying levels of all contaminants	Effect of NO_2 exposure on humans in reviewed	1 ppm, perceptibility threshold; 10–15 ppm, irritation of eyes, nose and upper airway 25 ppm, safety threshold of short term exposure
45	Varying levels of all contaminants	Effects of cynomolgus monkeys	6.78 ppm (NO_2 only), increased osmotic fragility of erythrocytes
27	88–167 ppm (NO_2 + NO)	Chronic lung disease in coal miners	88-167 ppm, 84% of the men had emphysema based on residual volume of more than 150%
28	1–5 ppm (1880–9400 ug/m^3)	Pulmonary function of healthy and diseased adults	Healthy adults: 5ppm (15 min), decrease in diffusion capacity Diseased adults: 4–5 ppm (60 min), decrease in arterial partial pressure of O_2 Healthy and diseased adults: 1–1.6 ppm (30 breaths); no effect; 1.6–2.0 ppm (30 breaths) increased airway resistance
29	0.10–0.15 ppm (188–282 ug/m^3)	Bronchitis rates of children exposed for 2–3 years	0.10–0.15 ppm, significantly higher bronchitis rates than children in low exposure areas
30	NO_2.0.005–0.09 ppm: CO.1–44 ppm: HC. 4.4–15.8 ppm	Chronic bronchitis in policemen	Increased chronic bronchitis. though not significantly, among policemen exposed for longer durations
31	2.9 ppm	Pulmonary effects on laboratory animals	2.9 ppm, significant pulmonary abnormalities

[a] Primary national standard (United States): -0.05 ppm per year.

HEAT SHRINKABLE TUBING

IRRADIATED POLYOLEFIN SHRINKABLE TUBING

MIL - 1 - 23053C/5A
UL RECOGNIZED COMPONENT*
AMS-3636B, 3637B.

The sing most widely used type of fit shrinkable tubing, FIT-221 is manufactured from irradiated cross-linked polyolefin. FIT-221 is an all-purpose tubing with excellent physical, chemical and electrical properties. It meets the most stringent military and industrial requirements for a highly reliable, thin wall insulation.

CHARACTERISTICS: High resistance to fungus and chemicals.
Self-extinguishing. Will not crack or peel.

APPLICATIONS: General purpose insulation, strain relief, jacketing material and as component insulation. Material is easily and permanently marked.

SPECIFICATIONS:
Operating temperature: -55°C to +135°C.
Shrinkage temperature: 135°C,
Tensile strength: 2500 psi.
Ultimate elongation: 400%.
Longitudinal shrinkage: 5% maximum.
Dielectric strength: 1300 volts/mil.
Non-flamable - Self extinguishing.
Specific gravity: 1.3 maximum.

Alpha No. & Size (inch)	Min. I.D. Before Shrink (inch)	Recovered I.D. After Shrink (inch)	Recovered Nom. Wall Thick (inch)	Standard Package 4' Lgths Total Fig.	2' Lgths Total Fig.	6" Lgths Total Fig.	Bulk Package 4' Length Total Fig.
FIT-221	.046	.023	.016		100	20	1,000
FIT-221-1/14	.063	.031	.017	100	100	18	1,000
FIT-221-1/22	.093	.046	.020	100	100	16	1,000
FIT-221-1/8	.125	.062	.020	100	100	14	1,000
FIT-221-3/14	.187	.093	.020	100	100	12	1,000
FIT-221-¼	.250	.125	.025	100	100	10	1,000
FIT-221-3/8	.375	.187	.045	100	100	8	1,000
FIT-221-½	.500	.250	.025	20	20	7	200
FIT-221-3/4	.250	.375	.030	20	20	6	200
FIT-221-1	1.000	.500	.035	20	20	4	200
FIT-221-1½	1.500	.750	.040	20	20	2.5	200
FIT-221-2	2.000	1.000	.045	20	20	1.5	200
FIT-221-3	3.000	1.500	.050	8	8	1	100
FIT-221-4	4.000	2.000	.055	8	8	5	100

STOCK COLOURS: Black, White, Red, Yellow, Blue, Clear

Standard Package FIT-221: Tubing is available only in specified packages.

When ordering, indicate package desired.

*UL marked tubing available on request.

May be cut and marked to your specifications.

Package Assortments

FIT-221 - Assorted sizes and colours per box.

- contains an assortment of 1' lengths in various sizes and colours.

Every length identified as to size and supplied in black, white, red, yellow, blue and clear.

ALPHA NO.	TUBING SIZE & RANGE	LENGTHS PER BOX
FIT-221-MS-1	3/64" THRU 3/16"	30
FIT-221-MS-2	1/4" THRU 3/4"	16
FIT-221-MS-3	1" THRU #4	10

Pre-cut lengths of FIT-221 in the two most popular cut sizes. Packaged in poly bags & boxes. Specify size.

ALPHA NO. & SIZE (INCH)	NO. CUT PIECES ½" OR 1"	ALPHA NO. & SIZE (INCH)	NO. CUT PIECES ½" OR 1"
FIT-221-1|64	1000	FIT-221-3|8	1000
FIT-221-1|16	1000	FIT-221-½	100
FIT-221-1|24	1000	FIT-221-3|4	100
FIT-221-1|8	1000	FIT-221-1	100
FIT-221-1|16	1000	FIT-221-1½	100
FIT-221-¼	1000	FIT-221-2	100

GLOSSARY

Aerosil - fumed silica; inert thixotropic dry filler for organic resins (also cab-o-sil).

Acrylic Emulsion - 100% acrylic liquid resin.

Benzoflex - (Benzoflex 9-88) plasticizer; flexibilizer for organic resins.

Fiberglass Tape - Fiberglass filament reinforced packing tape.

FRP - Fiberglass reinforced polyester (fiberglass).

Microballoons - Glass bubbles; hollow glass spheres, non-thixotropic inert resin filler.

Pearlescent Powder - TiO_2 - type dry pearl colorant powder used in cosmetics and pearl paints; nacreous powder.

PVC - Plastic tubing (of the Tygon B-44-4X type).

Queen's Formula - (16T8) A proprietary organic preservative developed at Queen's University, Kingston, Ontario.

Rhoplex - 100% acrylic liquid resin.

Silastic - Room temperature vulcanizing (RTV) silicone rubber compounds made by Dow-Corning.

Vacuum Former - The unit referred to was a small (12" x 18") lab former with a felt-covered draw-through forming platen. This machine was not very efficient, as it used a vacuum-cleaner-type system to draw the plastic over the molds. (A vacuum surge-tank system would have been preferrable.)

Vinyl Sealer - Alcohol-based, clear, low-sheen sealer.